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Planning the Management, Operation, and Maintenance of Irrigation and Drainage Systems

A Guide for the Preparation of Strategies and Manuals

International Commission on Irrigation and Drainage



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A Guide for the Preparation of Strategies and Manuals

International Commission on Irrigation and Drainage

The World Bank
Washington, D.C.

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ABSTRACT

This book has been prepared to help organizations responsible for operation and maintenance of irrigation and drainage systems to develop strategies and prepare plans for proper and effective operation and maintenance. It provides the basis for the preparation of manuals necessary for managers and staffs to perform needed activities at the proper time. The guide provides a comprehensive list of issues that should be addressed in operation and maintenance manuals for irrigation and drainage systems, and a listing of published materials and working papers which will assist in the formulation of plans for operation and maintenance.

This guide should serve as a valuable tool to help improve performance of irrigation and drainage systems. It was prepared to assist managers in developing and improving effective organizations to serve water consumers better.

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FOREWORD

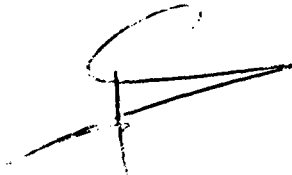
Good management, efficient operation and well-executed maintenance of irrigation and drainage systems are essential to the success and sustainability of irrigated agriculture. They result in better performance, better yields from crops, and sustained production.

Unfortunately, management operation and maintenance are often poorly carried out. The main reason has been generally attributed to inadequate finance. While it is clear that adequate finance is a prerequisite, experience has shown that weaknesses in institutional, technical, and managerial aspects of an irrigation and drainage organization are also important factors that constrain good system performance.

For more than a decade, the International Commission on Irrigation and Drainage (ICID), and the international irrigation and drainage community have made a special effort to address issues related to management, operation and maintenance of irrigation, and drainage systems. For example, Questions 35 (Athens, 1978), 36 (Grenoble, 1981), and 40 (Casablanca, 1987), of previous ICID Congresses, have been devoted to these topics. In addition, a Working Group in ICID, with assistance from the World Bank, has been engaged in the preparation of a guide to help irrigation and drainage organizations prepare the necessary strategies and manuals to achieve an efficient performance. Preparation of this document has taken several years of effort by dedicated practising engineers, managers, and staff people in irrigation and drainage organizations.

This guide is based on case studies from various parts of the world. It reflects primarily experience in countries where English is used and, therefore, we look upon this publication as a first edition. We expect to improve the guide with each subsequent edition. The second edition will incorporate experience from Francophone and other countries, and will be published in French and English hopefully by the end of 1990. With this in mind, we sent a preliminary French translation to the Secretary General of ICID and to the French National Committee. Improvements can only be made if comments and suggestions are received from National Committees and users of the document. We thus urge users and reviewers of this document to send comments and suggestions to:

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PREFACE

With increasing recognition of the need for more effective management, operation and maintenance of both new and existing irrigation and drainage systems, many National Committees of ICID have requested that this issue be addressed by the Commission.

The production of written documentation on O&M procedures was agreed to be of high priority.

In 1983 the Permanent Committee on Construction and Operation established four Working Groups to address current issues. To one of these, the Working Group on Management, Maintenance and Operation, was assigned the task of producing a Guide for an O & M Manual.

The Working Group comprised:

Chairman: Mr. J.M. Schaack

Members: Messrs. C.L. Abernethy (UK); D.J. Constable (Australia); P.R. Gandhi (India); H.M. Hill (Canada); Horst (Netherlands); M. Ait Kadi (Morocco); L.S. Pereira (Portugal); G. Piccolo (Italy); H. Shimura (Japan); H. Tardieu (France); L.O. Weeks (USA); B.C. Garg (Secretary, ICID).

Permanent

Observers: Messrs. G.P. Hawkins (USA); G. Le Moigne (World Bank); W. McCreedy (UK); E. Shultz (Netherlands); T. Wickham (IIMI).

Working Group Members provided the framework and background papers from which the Guide has been produced.

PRODUCTION OF GUIDE

The assistance of the World Bank and the valuable support of Mr. Guy Le Moigne of the AGRPS Division is gratefully acknowledged in providing facilities and funding of the Workshops and for the final production of the Guide by a joint ICID/World Bank editorial group.

The members of the editorial group comprised:

Mr. D.J. Constable (Australia), Chairman
Mr. H. Frederiksen (World Bank, Washington, D.C.)
Mr. H.M. Hill (Canadian National Committee, ICID)
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Mr. J. Sagardoy (FAO, Rome)
Mr. J.M. Schaack (USA National Committee, ICID)

DEFINITIONS

**"As Built" or
"As Constructed"** Record plans of a structure or facilities, amended to show any modifications or alterations, so that it provides a representation of the status.

Corporate Planning: An integrated approach to the management and coordination of the total range of activities for an agency. It points the agency to the future by requiring it to rigorously and systematically

- o review its purpose;
- o assess where it is now;
- o decide where it ought to be in response to Government requirements and client needs;
- o establish how and when it should get there; and
- o monitor its progress

(Also known as Strategic Planning)

Objective: A statement reflecting values or desired outcomes, related to a vision of the future. In a systematic process, objectives are hierarchical in order - broad in scope at the top level of management, more specific and detailed at the action level.

**Plans, Programs,
Budgets:** A set of detailed activities to be implemented in accordance with the agreed strategy.

"Satisfactory" In relation to level of service - is used in this manual to designate the concept that regardless of the methods used to deliver water and maintain the system, the water users must deem them to be acceptable.

Strategy: The line of action and key priorities established to achieve an agreed objective.

For explanation of technical terms used through the Guide, reference can be made to the Glossary produced by ICID.

INTRODUCTION

The Guide has been prepared as a reference document for organizations that are responsible for the operation and maintenance (O&M) of irrigation and drainage systems.

The aim of the Guide is to assist such organizations in developing their strategies and in preparing plans for O&M (POM).

Within this general objective, the Guide provides a basis for the preparation of O&M Manuals which give the essential operating instructions to managers in the field and other O&M staff, and which form part of the POM.

There is a multitude of activities, programs and functions which must be effectively planned, executed and coordinated if the organization is to discharge those responsibilities assigned to it.

The more important of these responsibilities are obligations to operate and maintain the facilities to meet the project capability as designed and constructed, but also to meet the expectations of its water consumers and their dependent communities on an ongoing basis.

The Guide in itself is not intended to give specific instructions and directions for all of those activities and programs. Rather, its purpose is to provide a comprehensive list of all issues to be addressed, together with a listing of published material and working papers which will assist in the formulation of a specific POM and its associated manuals.

A. CONTEXT AND SCOPE OF THIS GUIDE

There is a multitude of organizational arrangements represented by the collective experience of the many countries of the world in which irrigated agriculture is practised, and a variety of water distribution systems. Within these arrangements, there are many different management systems by which responsibilities for operation and maintenance of a particular irrigation network may be assigned to one or more agencies, or to a unit or units of a particular agency.

These organizational arrangements may have evolved from custom or be a result of a specific decision to establish institutions to achieve particular goals relative to improving performance in the irrigated agriculture sector.

The organizations may:

- o range from Government institutions through to privately-managed Associations or Cooperatives of water users with little Government involvement.

- o comprise multi-purpose, multi-functional bodies with a wide range of responsibilities, or special purpose organizations with water management in one project, as a primary role.
- o be financed totally by Government or private funds or by a combination of the two.

The water distribution system being managed may be:

- o long-established "traditional" schemes
- o existing schemes which have been rehabilitated or modernized
- o newly-commissioned project
- o "run-of-the-river" diversions that involve large headworks storages and complex distribution multi-purpose systems

A more comprehensive discussion of these alternative arrangements is set out in the publication "Organization, Operation and Maintenance of Irrigation Schemes" by the Food and Agriculture Organization [Ref 55]. Some examples are shown in **Annex 2**.

It is against a background of such diversity in management systems that these guidelines have been developed.

The general approach has been to set out essential principles which should guide the development of an effective Plan for Operation and Maintenance (POM) and a list of references which will assist in providing the detail for the POM specific to a particular system.

The Guide includes by necessity, some brief and generalized discussion of Institutional Planning and Management arrangements, as a necessary framework within which effective operation and maintenance activities will be performed.

In this context, the Guide has been directed primarily to public sector irrigation schemes, in view of the circumstances that:

- o the management, financial and personnel processes are frequently less flexible than for private schemes, because of the need to conform with central Government administrative requirements.
- o public sector schemes are usually large in extent compared to many private schemes, and mostly involve a wider range of issues to be comprehended in the management processes.

However, many of the specific procedures listed, particularly those dealing with operation and maintenance of the physical elements of the system, are directly applicable to private sector projects.

B. PLANNING FRAMEWORK

(a) Plan of Operations and Maintenance (POM)

One of the key objectives in the management of an irrigation and drainage system is to provide levels of service as agreed with Government/Project Manager and consumers at minimum achievable cost.

To meet that objective, and assure the ongoing integrity of the facilities embodied in an irrigation project calls for management skills of a high order. Those skills are required to coordinate effectively the elements of staff, equipment, and the physical and financial resources involved in the project.

A Plan for Operations and Maintenance (POM) is required to establish a strategy for the achievement of these objectives. The POM will form one of the set of management plans, others dealing with such issues as human resources (manpower), finance and development as described in paragraph (b) below.

The POM is a permanent set of documents and instructions, organization charts, work programs and schedules, updated when changes are made, so that it comprises a complete statement for reference and guidance at every level in the project organization.

A major component of such a POM will be a Manual comprising a number of sections dealing with each of the activities and functions. For larger projects, separate volumes for individual sections will prove more workable, and many sections will be comprised of numerous individual manuals.

(b) Institutional Planning and Management

(i) Integration of POM with institutional planning processes

Effective management of an organization requires a clear statement by Government or other relevant authority of the organization's mission, or purpose, its powers, and those functions which the organization is to carry out, and for which it is to be accountable.

The Senior Management of the organization by the process described below will develop a number of key objectives to be reached in carrying out the mission, which will provide clear guidance to staff in the development of policies, programs and activities.

These policies and programs will be set out in a number of statements as Plans, and companion documents to the POM.

These plans constitute the outcome of an integrated planning and management process. The process provides for a "top-down" approach to priority/direction setting and a "bottom-up" approach to devising detailed strategies and activities. In this process, responsible managers within the organization prepare proposals for programs and activities to achieve the objectives and goals established by Senior Management.

Once approved, these proposals constitute the plans which the organization will implement. This integrated or corporate planning process as it is known, provides for the various planning, operational and supporting activities across the organization to be brought together.

This is done by examining three basic questions.

- **Where are we now?**

An analysis for the organization of:

- (1) the current and forecast external environment in which it will be operating
- (2) its existing strengths and weaknesses

- **Where do we want to be?**

- (1) the formulation of a set of hierarchical objectives
- (2) objectives of purpose (mission and broad objectives)
- (3) objectives of strategy (strategic objectives)
- (4) objectives of tactic (operational objectives, i.e., specific, realistic, achievable, but challenging objectives with time-based targets)

- **How do we get there?**

- (1) formulation of strategies, programs and activities directed towards achieving the established and approved objectives
- (2) objectives essentially reflect values or desired outcomes. In the context of managing irrigation distribution systems, the development of the objectives for the organization requires an understanding of the needs, demands and expectations of water users and landholders. The objectives are hierarchical in order, all relating to a view of the future, which will

range from a broad view at the highest level to a detailed, specific outlook at the activity level.

- (3) the corporate planning process provides a systematic, integrated approach to the management of the total range of activities of an agency. It is an iterative process, involving for each specific objective:
 - a. identification of key result areas, i.e., activities which most significantly affect the level of overall performance in the particular area under review
 - b. diagnostic analysis and identification of options for improvement in those areas
 - c. development and implementation of programs
 - d. monitoring and evaluating progress against agreed performance criteria
 - e. review of plans and programs

References [55], [77], [78], [79], and [80] provide additional detail of these processes.

(ii) The Corporate Plan

The full set of management plans comprises the overall corporate (or strategic) plan for the organization. A key requisite to the development of effective Corporate Plans is the set of memoranda of understanding, including clear assignment of functions, funding responsibilities, control and regulatory functions that may be divided between the irrigation organization and others, including Government.

The Corporate Plan will normally set the directions for the organization for the short- to medium-term, say 3 to 5 years, and be updated periodically, generally on an annual basis.

The Corporate Plan provides the basis and priorities for the development of annual work plans and budgets, coordinated across the organization.

A typical set of management plans might comprise the following:

- **Development Plan**

Outlining:

- (1) new services to be provided

- (2) new facilities, programs or activities
- (3) major modernization or augmentation of existing facilities
- (4) services to be developed to Water User groups or landholders
- (5) services to be diminished or discontinued

- **Plan for Operations and Maintenance**

- (1) a permanent set of documents and instructions, work procedures, programs and schedules
- (2) as described in paragraph (a) above

- **Management Support Plan**

- (1) development and review of organizational structure
- (2) development of management information systems
- (3) technical and administrative support
- (4) size, type and location of accommodation to meet perceived needs

- **Human Resources Plan**

- (1) categories and levels of resources to carry out specific tasks
- (2) skills required, or not required, to address future activities
- (3) training needs analysis based on programs in the three plans above, outlining:
 - . regular or routine ongoing training programs, e.g., induction, skills training, management training
 - . special programs to meet specific needs

- **Financial Plan**

- (1) expressing the extent of the organization's agreed programs in monetary terms
- (2) indicating sources of funds and cost recovery policies and targets

For organizations or organizational units charged only with the responsibility for O & M of a particular water delivery system, the dominant plan will be the POM, and there may be no Development Plan, while the other elements of the Corporate Plan may be formulated by the parent institution.

(c) Annual Work Plans and Budgets

The aggregated budget for the organization and the associated work plans reflect the agreed priorities of the organization. The various Annual Work Plans, of which the POM is generally the most significant, constitute successive annual Corporate Plans.

C. FORMULATION OF POM

(a) Using the Guide for Production of O & M Manuals

(i) Managing the Process

The POM is described as one of the set of management plans, being a permanent set of documents and instructions, organization charts, work procedures, programs and schedules, updated when changes are made, so that it comprises a complete statement for reference and guidance at every level in the project organization (refer to Section B. PLANNING FRAMEWORK of this document).

A major component of such a POM will be a Manual comprising a number of sections dealing with each of the activities and functions. For larger projects, separate volumes for individual sections will prove more workable, and many sections will be comprised of numerous individual manuals.

For new projects, the production of O&M manuals should proceed through design and construction phases of the project implementation so that manuals will be available to operating and maintenance staff when the project is commissioned.

For existing projects where no comprehensive set of manuals currently exist, the production of the manuals will involve a number of individuals within the organization, sometimes also involving people with particular expertise from outside the organization. For all but the very simple systems with relatively few control structures, the production of manuals will extend over a considerable period, even years in some cases.

In either situation, it will be necessary to assign within the organization, the responsibility for managing the production process, as distinct from the task of writing the technical contents of the individual sections.

The activities which need to be coordinated include:

- fixing the broad scope of the manual and its individual sections
- establishing guidelines for format and style, so that individual sections can be clearly identified as being part of the set (maintaining "a corporate image")
- fixing a time-based schedule for completion of sections
- nomination of authors of individual sections
- controlling the printing and distribution of completed sections
- arranging for review and updating

Remember, these manuals form the essential building blocks on which the operational procedures, work programs and consequential annual budgets will be developed. They are vital to the successful formulation of an effective POM for any organization.

(ii) Steps in Developing the Manual

- Step 1

Ensure that:

- (1) a clear Mission statement or statement of the essential purpose of the organization is available
- (2) the type and nature of the organization is understood
- (3) the legal standing, and relationship and linkages to other units or organizations is clearly defined

- Step 2

With the information in Step 1 in mind, re-read the introductory parts of the Guide, viz., CONTEXT AND SCOPE OF THIS GUIDE and PLANNING FRAMEWORK, to assist in interpreting and using the relevant information set out in Chapters 1 to 8.

- Step 3

Assign responsibility for coordination as outlined in Section A paragraph (a) above.

- Step 4

For new projects, read Section (b), paragraphs (a) to (d) following this section, and proceed accordingly.

- Step 5

For existing and new projects read Chapter 1, and set out the functions and management framework relevant to the particular organization or unit.

- Step 6

Read Chapter 2 and establish the catalog of facilities for which the organization or unit has responsibility for operation and maintenance.

- Step 7

For the range of functions and category of facilities determined Steps 5 and 6, apply the appropriate provisions of Chapters 3 to 8, in developing the relevant contents of sections of the Manual, in accordance with the timetable and procedures established in Step 3.

(b) Procedures for New or Modernized Projects

The task of the O&M unit in formulating the POM must commence very early in the project planning phase, and will continue through the Planning, Design, Construction, Commissioning and Operational phases.

(i) Project Planning Phase

Project O&M must be addressed by knowledgeable O&M specialists in as comprehensive a manner during project planning in the same way as any other aspect such as selection of the conveyance system or determination of the agricultural activities in relation to their costs.

In particular, the optimization of O&M/capital costs is vital, and the planning process should clearly expose the extent of any trade-offs in future O&M costs in planning options before final decisions are made.

Planners must recognize that every decision pertaining to the farm services or system facilities directly affects the long-term operation and maintenance function and its costs. Of primary concern in planning should be:

- the operational feasibility of the scheme relative to services intended and facilities selected

- realistic costs of operation and maintenance to assure continued project integrity
- the specific O&M facilities, communications, equipment, complement of parts and supplies
- the advance staffing and training, and pre-transfer preparatory work of O&M that must be completed before the project commences services. The substantial capital budget item for O&M must be carefully estimated

The O&M matters that must be addressed during project planning and be fully reflected in the project feasibility report include:

- irrigation, drainage and flood control services to be provided to farmers and the related services to villages and Municipal and Industrial (M&I) customers
- water allocations to individual farmers and customers and any interim modifications to utilize surplus water during project build-up
- role of farmers in determining specifics of irrigation scheduling and system operation and maintenance
- organizational structure of the O&M unit including geographical bounds of the functional sub-units
- data collection needs for purposes of O&M, extent of remote monitoring and control, and basic communication needs
- configuration and siting of offices, shops, storage areas and housing
- the complement of fixed and mobile equipment including back-up supplies and spare parts
- schedule for completion of O&M facilities, procurement of equipment and supplies and placing and training staff to meet scheduled start-up of operations
- cost estimates of O&M facilities, equipment and back-up
- cost estimates of initial staffing
- cost estimates of annual operations including salaries, supplies, utilities, vehicles and allowance for staff replacement and training
- cost estimates of annual replacement and maintenance of system facilities, equipment and buildings

(ii) Design Phase

Aspects of project O&M that are addressed during planning must be finalized during the design phase. These relate to:

- detailing the scheme of operation (i.e., controlled-volume, free draining, remote/on-site control, etc.)
- design of the overall conveyance/delivery system
- the control, monitoring and communications system
- the specific O&M offices, shops, yards and related features

Preparation of procurement documents for the O&M equipment will have to be completed. At the same time, new tasks must be started. The specific O&M matters that must be addressed during the design phase include:

- procurement documents for the initial complement of O&M equipment, supplies and spare parts
- detailed schedule for placing the system into O&M status and related actions
- final cost estimates for annual O&M costs
- staffing of initial project O&M personnel

(iii) Construction Phase

Several aspects of project O&M must be pursued during the construction phase. In addition to those noted under the design phase, the dominant areas will be:

- installing the O&M organization in the field
- commissioning of project facilities
- transferring responsibility from construction to O&M

Due to the typical staging of the project completion, construction will be underway in some areas, while full O&M will be in place elsewhere.

The specific matters that must be addressed include:

- finalizing POM and distributing together with other documents
- recruiting, placing and training O&M staff prior to start-up in accordance with schedules

- farmer groups, if such are to be established, and elected/ designated officers
- orientation and procedural meetings with farmers and farmer groups
- trial operations - internal and with farmers
- trial maintenance - internal and with farmers

(iv) Project Commissioning Procedures

Following commissioning of a new project, the O&M unit accepts full responsibility for the operation, maintenance and management of the completed project facilities. However, it is necessary that the O&M unit will have been involved in considerable preparatory work in the formulation of the POM.

Besides the preparatory work by the O&M unit, several documents are to be prepared by other units in the irrigation agencies

The documents include:

- Project Feasibility Plan
- Designers Criteria
- Designers Instructions to O&M
- Right of Way Instructions for O&M
- Construction/Supply Contract Documents
- As-built Drawings and Manufacturers Instructions
- Facilities Commissioning Procedures
- Initial Complement of Equipment and Supplies
- Initial Complement of Staff

Inputs to these documents will be required from the O&M perspective by the initial O&M unit staff assigned that responsibility.

Further details of these documents are set out in Annex 1.

(v) Operational Phase

Implementation Action Program:

a clear description, including timing is necessary for activities required for the phasing-in of project O&M

The issues to be included are:

- completion of system facilities
- commissioning of components
- transfer from construction to O&M
- commencement of services to each area
- preparatory O&M tasks, including:
 - (1) detailed work plan
 - (2) completion of O&M facilities
 - (3) equipment procurement
 - (4) staffing and training
 - (5) start-up procedures for services
- ongoing program

The matters to be resolved are discussed in Sections 1 to 8 of the Guide.

(vi) Update for Subsequent Project Stages

In some cases, a large project may be implemented in stages. Not infrequently, a considerable period may elapse between the commissioning of one stage, and the commencement of planning for the new stage.

The experience of actual operation of the initial stage or stages is invaluable in planning and implementing later stages.

All of the preliminary activities outlined in Section (b), paragraphs (a) to (e) should be completed in the sequence listed for the facilities involved in the new stage.

CHAPTER 1: ORGANIZATION, MANAGEMENT AND RESPONSIBILITIES

Effective management of an organization, or unit, requires a clear statement by the relevant management authority of the unit's mission or purpose, and those functions which the organization is to perform, and for which it is to be accountable.

The Mission statement should provide a concise statement of essential purpose for which the organization or unit has been established. This statement should provide a clear indication to people within and outside the organization as to the end to which the main thrust of organizational effort is directed.

For example, the Mission statement for an organization managing a discrete system to supply irrigation water to farms in the project area might read as follows:

"To operate and maintain the project facilities to supply crop water requirements to farms within the project area".

From time to time during the operational life a project, circumstances may arise which require a particular management effort directed towards achieving a specific outcome over a period of some years, such as:

- o intensifying the cropping system
- o changing the cropping pattern
- o modernizing the system
- o soil salinity control
- o water table control

In such circumstances, this change of emphasis might be reflected in a review of the Mission statement, as part of the process of re-focussing organizational effort to meet a newly perceived need.

The purpose of this Chapter is to specify, for the unit responsible for operation and maintenance of the whole or part of a physical system, the management framework within which it will perform the functions assigned to it. **Annex 2** contains some examples.

The following issues need to be addressed:

- o Pertinent Project Policies, within which the O&M function is to be exercised
- o Functions
- o Objectives and Goals

- o Functional units and responsibilities
- o Detailed organizational structure
- o Relationship with other public and private organizations
- o Public Relations

A. PERTINENT PROJECT POLICIES UNDER WHICH O&M
FUNCTION IS EXERCISED

The policies governing the access to water resources, the conveyance and distribution of water and the relationship of the organization with the farmers should be reflected here. Often these policies are condensed in a legal or contractual document which is the "Rules and Regulations" Document discussed in Chapter 6. Where this is not the case it will be important to include them here.

There may be two elements embodied in the provision of an irrigation supply:

- o Access or title to the water itself, expressed as a right to a specified volume on an annual basis -- commonly called a "Water Right".
- o Collection, conveyance and distribution of water to farm boundaries, in accordance with agreed rates of supply and delivery periods, either with or without limits to total volume of supply.

Depending on particular national policies and customs, and general availability of water, a formal water right allocation process may not exist. Where it does exist, such a system has been adopted where water supplies are limited, and/or where there is competition for their use. Water Rights may be granted by administrative action of a Central Water Agency acting on behalf of Government, or acquired under processes specified by Water Law.

Basically the set of policies should cover the following main issues:

- o The water rights governing the access to water by individuals and the organization. Where the access to water is not regulated by water laws indicate how the entitlement to access water is defined.
- o The main criteria that will govern the water allocation and distribution. Particular attention to be paid to the measures to be adopted during emergency and droughts, and the priorities to be applied in case of storage of water under more normal circumstances.

- o The entitlements of the organization to dispose of excess water, as well as those of the farmers.
- o The rights of farmers to excess water.
- o The criteria to be used in the maintenance programs such as the use of contractors, casual labor, or machinery.
- o The main criteria that will govern the relations with the water users.
- o Regulatory provisions and disciplinary measures.

B. FUNCTIONS

Here will be spelled out the functions for which the O&M organization will have sole or major responsibility. Generally, the following functions are to be covered here:

- o Establishment of policies
- o Management - overall direction and coordination
- o Water resources - securing supply
- o Water distribution - including protection and security of source
- o Maintenance of facilities
- o Planning and design
- o Administration
- o Programming and budgetary control
- o Financing and auditing
- o Monitoring and evaluation
- o Safety

additional functions:

- o Flood control
- o Navigation
- o Recreation
- o Power generation
- o Fish and wildlife enhancement

- o Water supply for municipal and industrial use
- o Assistance to farmers on irrigation practices and on-farm development
- o Judgement and punishment of offences made against the rules and regulations
- o Collection of fees and charges and other special functions.

The meaning and extent of those functions should be spelled out here. For instance, it may be necessary to specify that

- o the establishment of policies refers only to those that are related to the operation and maintenance of the systems.
- o the planning and design refers only to the improvements and rehabilitation works that will be carried out within the context of maintenance programs.
- o some of the above-mentioned functions are carried out by other entities or units outside the O&M organization, (as could be the case with the monitoring, evaluation, and auditing that are often carried by external or independent units).
- o certain functions will be carried out by the private sector or by contract.

How these functions are carried out, and by whom, is specific to every project. For instance, in the private sector the establishment of policies is given in many irrigation projects by a Board of Directors elected by the farmers. In public irrigation projects, the policies are sometimes dictated by higher levels of the organization or special committees and so on, sometimes in consultation with water users organizations.

However, it will be important to specify which of the above functions will be carried out by the O&M organization and those that farmers are expected to undertake by themselves.

Annex 2 has a number of examples of organizations and related functions statements.

C. GOALS AND OBJECTIVES

The goals and objectives, as here referred to, are those of the organization that deal specifically with the operation and maintenance of the physical systems (irrigation, drainage, roads and buildings). This organization may be one in itself or may be part of the overall project organization, in the latter case it will be important to describe the relationships and hierarchical dependencies between the two of them.

The objectives should be described in as much detail as possible, classifying them in short- and long-term, where possible. Typical long-term objectives of an O&M organization are:

- o To provide a "satisfactory" operation and maintenance of the physical facilities of the project. "Satisfactory" is used here to designate the concept that regardless of the methods used to deliver water and to maintain the systems the water users must find them acceptable;
- o To maintain the system in "satisfactory" operational condition in perpetuity, in conformance with the original design or approved design modifications;

(The term "satisfactory" operation and maintenance is synonymous with agreed, approved or negotiated level of service)
- o To provide that "satisfactory" service at minimum achievable cost, and depending on particular national policies;
- o To recover costs of operation and maintenance from beneficiaries.

Depending on local circumstances and the actual range of functions, other objectives may be added relative to those additional functions, for example:

- o allocating available water resources to different users within the project boundaries.
- o control of the groundwater abstractions.
- o establishing priorities for water use etc.
- o collecting fees and water charges.

The short-term objectives should be described as specifically as possible, together with a relevant time-frame for their achievement. These will refer to discrete activities directed towards the achievement of the longer term objectives.

D. FUNCTIONAL UNITS AND RESPONSIBILITIES

Every unit of the organization should have a clear description of its responsibilities. This is an essential requirement for the proper functioning of the organization. It is important to record not only the functional responsibilities but also the geographical coverage.

The number of units for which these responsibilities will have to be described depends on the complexity of the organization and the number of essential functions that will be carried out in each case. In most cases a description of responsibilities will be required for the following:

- o General Direction (Board of Directors, Commissioners, Special Committees, Director-General, General Manager, Chief Engineer, etc).
- o Director, or Manager, Office,
- o Operations Department. This could include other units like: Water measurement, Water Distribution, etc..
- o Maintenance Department and its subdivisions by hydraulic sectors or type of works to be executed,
- o Administration and Finance Department,
- o Farmers constituencies (general assembly, consultation bodies and others).

Several functions providing direct assistance to the project manager will be required to support the "line" functions outlined (a) to (f) above. These are frequently defined as "staff" functions. Frequently these are provided by individual staff members. Special training and in-depth experience are essential to assure the high level of advice sought by the manager. On smaller projects these functions may be provided by higher level state organizations or even private individuals. Regardless, a concise statement describing the function and all subordinate activities, reasons for providing the assistance any related procedures must be prepared. The functions would embrace:

- o Staff functions
 - Legal
 - Internal financial audit
 - Project performance evaluation
 - Safety
 - Environmental monitoring

Where the organization undertakes additional functions, specific units may be required to deal with them, like:

- o On-farm irrigation and Drainage Department
 - o Laboratory service,
- and others, as may be required.

E. DETAILED ORGANIZATIONAL STRUCTURE

The next step is to describe how the above functions and duties are discharged by organizational units and how the dependence and lines of authority are established. The most effective way of presenting this information is by an organizational chart with the necessary annotations.

A few observations appear relevant in this context. Experience all over the world is proving that too little attention is paid to the establishment of Evaluation and Monitoring Units but they are of great importance in assessing the performance of irrigation projects. A question that needs particular attention is whether operation and maintenance should be undertaken by a single unit or by two separate units. (For an extended discussion of this issue see [reference 55]).

Some examples of organization charts are included in **Annex 2**.

F. RELATIONSHIP WITH OTHER PUBLIC AND PRIVATE ORGANIZATIONS

The organization that manages the physical facilities of an irrigation project is sometimes part of a much larger organization that provides many services to the users, and in this case it will be necessary to describe the institutional links with the larger organization. However, even when this is not the case, the links with other organizations such as:

- o Land management
- o Research
- o Extension
- o Hydrological assessment
- o Credit schemes
- o Environmental and recreational agencies,

should be described, indicating the extent of the information, cooperation, or services provided, as well as the channels of communication between the respective organizations.

G. PUBLIC RELATIONS

Good public relations involve good communication. Here the communication channels between the project organization and the water users are to be mentioned. Particular attention will be paid to the need for reaching all the water users and giving them the possibility of addressing the O&M organization when necessary.

The other aspect that also needs attention is the communication between the irrigation organization and the general public. This implies the use of mass media and other means to promote some efforts in the farming community or to pass relevant information in a rapid and effective way.

CHAPTER 2: PROJECT DESCRIPTION

A. GENERAL PROJECT FEATURES

The general project features and service areas should be described to facilitate understanding by all individuals involved with the Project O&M.

A map or series of maps should be included to indicate:

- o topographic features
- o roads
- o utility lines
- o communities, and
- o any other general project area features that will be important for O&M operations

Specific project features will also require location maps. The irrigation and drainage system layout should be placed on these maps with details of:

- o distribution points
- o branches
- o water measurement facilities
- o crossing locations
- o dams
- o other water storage areas
- o pump stations
- o evaporation ponds
- o maintenance shops
- o offices, and
- o any other pertinent details

B. PROJECT FACILITIES

Detailed descriptions of all project facilities that will be operated and maintained by the organization will be necessary. The related project facilities that may affect O&M efforts should also be described to provide information that will facilitate efficiency and effectiveness of work. Details required include:

- o specific location
- o capacities
- o operating ranges
- o sizes
- o unique features
- o materials, and
- o any other pertinent descriptions

Some of these specific features are:

(a) Water Sources

- o storage dams
- o diversions
- o wells
- o facilities for mixing drain waters for re-use

(b) Water Distribution Facilities

- o canals
- o pump stations
- o pipelines
- o siphons
- o turnouts
- o water level and flow control structures
- o water measurement devices
- o spillways, and
- o related transmission and communication facilities

(c) Drainage System

- o outlet facilities
- o pump stations
- o main drains

- o lateral drains
- o bridges
- o subsurface pipe drains
- o culverts
- o water table observation wells
- o dikes, and
- o water entry structures along drains, and

(d) Flood Protection Banks

(e) Supporting Infrastructure

- o roads
- o utility lines
- o maintenance shops
- o material storage areas
- o offices
- o equipment yards
- o weather reporting system
- o hydromet system
- o parts depots etc.

Other detailed design criteria, geologic reports, as-built drawings etc. should be referenced in this section to be certain everyone knows where they are filed and can refer to them for specific details when necessary.

CHAPTER 3: SYSTEM OPERATION

A. GENERAL

This Chapter will provide specific, concise but detailed instructions for the operation of the irrigation system. It is to be used predominantly by operators in the field, and their supervisors and managers.

It will provide a formal documentation of operational procedures to assist in effective day-to-day operation, as well as providing a basis for longer term review and evaluation of policy and operational practices in the light of operational experience.

Two fundamental factors will influence the content of these instructions:

- o the method of water allocation and distribution adopted for the system;
- o the technology adopted for water control within the distribution system.

As emphasized in the introductory paragraphs - "Formulation of the POM", essential features of project operation should have been addressed during the planning, design and construction phases.

It follows, therefore, that the detailed instructions in this chapter should be compatible with the design features of the project facilities.

There are a number of activities to be addressed in the formulation of System Operation rules, which could be grouped under the following headings:

- o Detailed Operational Rules and Specifications;
- o Irrigation Plan (Seasonal and Annual Operating Plan);
- o Operational Procedures
- o Emergency Procedures
- o Operations below Farm Outlets

B. DETAILED OPERATIONAL POLICY, RULES AND SPECIFICATIONS

Here will be set out the essential specific policy guidelines and general operating criteria which system operators must take into account in determining detailed operational procedures.

These will be extracted and expanded, where necessary for operational purposes, from the relevant information contained in Chapter 1

and Chapter 2 - Organization Management and Responsibilities, and Project Description respectively.

They will include such matters as:

- o Water sources
 - any legal limits to water availability for project purposes
 - any water sharing agreements with external bodies or organizations
- o Priorities for delivery
 - normal availability from sources
 - restricted availability from sources
- o Categories of demand to be supplied
 - project requirements
 - municipal and industrial (M&I)
 - environmental flows
 - recreation flows
- o Requirements for "passed-down-river" flows to meet riparian entitlements, or entitlements of downstream projects or water users, in terms of either flow rate or water levels to be maintained.

C. IRRIGATION PLAN - SEASONAL AND ANNUAL OPERATING PLAN

This section of an O&M manual should provide specific instructions for preparing the seasonal/annual irrigation plan. The objective of the exercise is to match the water demand with the supply as closely as possible. This exercise is generally complex and reiterative, and the use of computers may simplify the calculations. The complexity of the process varies from case to case depending on the scope for manipulating water supplies to meet the demand.

The preparation of the irrigation plan includes the following main steps:

- o Estimation of water supply
 - wet season
 - dry season
- o Estimation of water demand of the users (derived from cropping or demand pattern)
- o Application of appropriate water allocation criteria and procedures
- o Matching supply and demand

The water demand is essentially determined by the expected cropping pattern, or strict allocation procedures in water short situations. Depending on the country's social, economic and other conditions, farmers may have free choice of their crops and timing of cultivation activity or, in other cases, cropping patterns may be strictly imposed by the government. Preparation of the irrigation plan should be in accordance with the particular circumstances.

This chapter should clearly define the rules to be adopted in matching supply with the demand. In irrigation projects where the management has control over the cropping pattern, a good method is the use of an approval form for individual farmers. When the management has no authority over the crop selection, the rules for sharing water deficits should be well defined, for example:

- o extending the interval between irrigation;
- o increasing the amount of water given by irrigation;
- o allocation of water to preferential crops.

A variety of well-known formulae exist for the calculation of crop water requirements which take into account effective rainfall, temperature, crop growth coefficients etc. A critical factor in the derivation of net irrigation requirements is the overall water use efficiency. This factor is often largely over-estimated at the planning stage and therefore the importance of monitoring operation activities to assess the actual value of conveyance, distribution and on-farm efficiency discussed in Chapter VIII should be emphasized here.

D. OPERATIONAL PROCEDURES

A specific set of written procedures and instructions will be required for each operating feature or item (or class) of plant, as indicated in the following sections

(a) Water Sources and Storages

The sources of water should have been determined during planning and documented. The quantity available should be determined (forecast and holdover) on a periodic basis so that supplies are known and plans can be made by the supplier and user.

Many irrigation systems utilize a reservoir, often a part of a multi-purpose scheme, to store water during periods of high river flow for subsequent use during periods of low flow. The dam which forms the reservoir is often a major structure and must be operated under specific rules and procedures. These rules are usually formulated during the planning, design, and operational phases.

Because of the critical nature of the dam and reservoir to the success of providing an adequate and reliable water supply specific rules should be documented and implemented for each dam and reservoir, including provisions for periodic inspection.

Since the planning, design, operation and maintenance of large dams is a highly specialized activity, irrigation agencies responsible for such facilities should refer to directions and procedures developed by the International Commission on Large Dams (ICOLD) and their National Committees, and the relevant specialized organizations within the country. Particular regard should be given to the requirements for instrumentation, monitoring and performance in the context of dam safety.

(b) Distribution of Water

Operation of a water delivery network may vary considerably depending on a number of water management factors, including but not limited to the:

- o climatic conditions, particularly the rainfall pattern;
- o degree of regulation of the sources of water;
- o quality of the water, particularly the silt content;
- o size of project;
- o number and type of farms;
- o number and category of other users;
- o type of conveyance and distribution facilities (open channels and/or buried pipes, etc)
- o method of water distribution; e.g. on demand, or pre-arranged demand, under a rigid rotational system, or under continuous flow.

The actual distribution of water includes two distinct steps:

- o the preparation of the irrigation system scheduling (indenting, ordering) at an interval to be determined;
- o the operation of the delivery system.

Procedures for these two activities should be clearly and carefully defined in the O&M manual since they are vital for the quality of services to the water users and will involve specific field staff.

(c) System Scheduling, Indenting, Ordering

The preparation of a system scheduling depends, as indicated earlier, on the method of water distribution and on the type of

facilities. The water order for an individual farm or group of cultivators or other users can be placed by each farmer or group, or decided unilaterally by the agency according to a pre-established scheduling. The preparation of the water delivery schedule can be simplified or even eliminated when part of the system is operated on demand/or is equipped with advanced water control facilities such as for downstream control or centralized remote control. Difficult areas in preparing a delivery schedule are the estimation of water propagation time, water use efficiencies and effect of rain interruptions. Knowledge gained from prior operational experience should be used in refining estimates.

Standard Forms should be prepared to facilitate the preparation of the system scheduling, such as forms for:

- o individual demand at lower level of canals;
- o aggregating water demand for lower level to headworks incorporating efficiency values at different levels of the system. Instructions to deal with rapid variations of demand due to rainfall prepared jointly with the users should also be included.

(d) Operation of the Canal System

- o Instructions should be formulated regarding:
- o System start-up and close-down;
- o Range of discharges in each canal (minimum and maximum values)
- o Authorized rate of change of discharge
- o Water level fluctuations at critical points of each canal (minimum, maximum, rate of fluctuation - normal and emergency)
- o Operating during rainfall season
- o Operation of all water control structures (cross-regulators, offtakes, wasteways, pumps, etc.)

If part of the system is operated under remote control, detailed instructions for system scheduling and operating should be prepared.

Depending upon the type of water control technology, forms should be prepared for recording flow and water levels at critical points of the irrigation system. This information is important for:

- o calculation of actual water use;

- o determination of actual water use efficiencies;
- o providing data for improvements in the system;
- o volumetric water charges where applicable;
- o longer term review and evaluation of policy and operational practices.

Given the enormous volume of information on canal operation and water delivery which needs to be recorded, stored, monitored and analyzed, the use of computer-based management information systems is proving advantageous if not essential in many countries. Such systems need to be carefully developed to ensure that all the information needs arising from the water distribution function for other units in the organization can be met without the need for multiple data bases. Careful attention should be given in the development of the computer programs to these other needs, as well as to providing for effective operational management. Refer also to Chapter 5.B: Management Information Systems.

E. EMERGENCY PROCEDURES

An Emergency Preparedness Plan (referred to as a Disaster Plan in some countries) should be developed for all facilities for which failure or malfunction could cause:

- o danger to human life;
- o substantial property damage;
- o loss of production;
- o disruption to other community activities;

Essential complementary parts of an emergency plan are the:

- o establishment of emergency depots with immediately available stockpiles of materials for rapid repairs; and
- o schedules of mechanized plant and equipment which would be available from the agency, or from other agencies in relevant areas.

(a) Dams and Major Structures

Given the nature of the hazards involved in structural failure or malfunction, and the specialized technology involved in these structures, reference should be made to ICOLD and other relevant organizations for relevant instructions in preparing the emergency plan, including inundation maps.

(b) Other Facilities

For other facilities, a number of situations need to be addressed, e.g.

- o excessive rainfall, flood routing;
- o blockages or malfunction of gates;
- o breaches or overtopping of canal banks;
- o breaches or overtopping of flood embankments;
- o obstruction of drainage structures;
- o chemical spills and pollution of waterways.

The Plan should indicate:

- o action to be taken to minimize damage or risk to structures;
- o action to minimize danger to life or other property;
- o internal reporting processes to be followed;
- o external communication and notification processes;
- o liaison requirements with relevant authorities;
 - civilian protection or evacuation
 - traffic control and diversion
 - flood routing procedures
 - water quality issues.

F. OPERATION BELOW FARM OUTLETS

Operation below farm outlets is the responsibility of individual farmers when water is delivered at the farm gate. However when farms are small, it is common that the project deliver water in-block at group level as found in many parts of Asia. In that case the cooperation and active participation of farmers is essential for efficient use of water. These require organization, skill and discipline. The responsibility for organizing Water User Groups (WUG) should be clearly defined. These WUGs could be organized in a formal or informal way. The overall responsibility is to distribute water among the farmer members within the area and sometimes also to maintain on-farm facilities. The organization and responsibility of each WUG and the rights and obligations of each member should be clearly defined in a separate document.

The distribution of water by the WUG is dependent on the supply of water in the main canal, laterals and sub-lateral being operated by the irrigation agency. It is therefore necessary for the agency to take responsibility for, and an active interest in, activating the farmers within the WUG.

The maintenance work where assigned to the WUG and consisting mainly of weed and silt removal in ditches and small repairs to structures should be carried out under the guidance of the irrigation agency.

G. COMMUNICATIONS

To make possible the flow of information required for operation within the system and between the project and the users, an efficient system of communication is necessary.

A full management information system is usually desirable, and this can be used by other authorities responsible for different aspects of an irrigation scheme, such as the extent and rate of planting and harvesting, and occurrence of pests and diseases.

Clear instructions should be provided to operating staff on timing and nature of data to be exchanged.

CHAPTER 4: SYSTEM MAINTENANCE

A. GENERAL

All policies and procedures for, and assignment of, maintenance responsibilities relevant to all system elements and maintenance functions will be included in this chapter.

The most visible function of an irrigation agency is the conveyance and delivery of water to the fields. However, sustained success in this function depends not only on the effective planning and execution of water distribution operations, but on a well-planned and executed program of maintenance for all facilities, including drainage and flood control facilities. That program in turn depends on well-developed support procedures.

Effective procedures, for example, for the acquisition, handling and issuing of stores and spare parts for plant and equipment are vital to success. Effective planning for maintenance, on the other hand, must also recognize the inescapable lead time involved in stores acquisition, particularly if overseas purchasing is involved.

The procedures in this chapter therefore, must be compatible with the general administration instructions contained in Chapter 5, and with the operational instructions contained in Chapter 32.

The chapter may contain a discussion of the approach to maintenance policy. In particular this may include a discussion and directions on the:

- o degree to which preventative maintenance, as opposed to identification and resolution of problems on an ad hoc basis, is to be relied upon;
- o appropriateness of deferring maintenance on facilities for which plans have been approved for modernization or rehabilitation;
- o approach to modernization of works during performance of maintenance activities, including the degree to which it is the intent to continually modernize the system, and the criteria for such decisions; and
- o the relationship between system maintenance, modernization and rehabilitation.

For these matters this chapter may include general directions as well as delineation of responsibilities within, as well as external to, the Operation and Maintenance Organization.

(a) Development of Work Plans

Routine maintenance which includes all work necessary to keep the irrigation system operating satisfactorily should be documented and detailed in work plans which should include the work to be accomplished for all elements of the system. This work may:

- o be performed on a periodic basis;
- o be identified annually to be included in the following years' work plan;
- o originate through an application of the two methods.

Data to be used in developing maintenance work plans may originate from:

- o reports from field personnel;
- o inspection reports from engineers, and
- o performance measurement data as outlined in **Chapter Eight**, among other sources.

Detailed instructions covering the formulation, completion, timing, and contents of work plans will be included in this chapter. Matters to be included are:

- o contents and format of work plans;
- o period for which plan is prepared (e.g. one year or longer);
- o definition and extent of work;
- o estimates of cost;
- o timing of work, schedules of programs;
- o method of execution - internal or external forces, contract;
- o assignment of responsibilities for execution of work;
- o priorities assigned - having regard to maintenance policies;
- o maintenance of services during work programs;
- o deadlines for provision of data;
- o submission of work plans, approval process;

- o notification and liaison - where work may affect activities of other authorities and individuals.

The assignment of responsibilities, as indicated above, should be reflected in job descriptions and assignment of responsibilities and delegations of authority as contained in Chapters 1 and 5. The Work Plans may cover a one-year period as well as longer periods. The planning periods to be covered in work plans should be stipulated and be consistent with the general budgeting and planning approach outlined in Chapter 7 and the institutional planning processes outlined in the Planning Framework.

(b) Special Reserve Funds (Contingency Funds)

It may be appropriate to include in the budget, a special reserve fund to be accessed to repair or maintain the system in the event of unforeseen needs. This may include damage caused by major disasters, such as floods, earthquakes or structural failures. This chapter should state the criteria under which such a fund may be accessed as well as other general provisions for maintenance and administration of an adequate fund.

(c) Maintenance of Record Plans

A general policy on the storage and maintenance of as-built plans, right of way plans and the updating of these plans as they are modified during maintenance activities should be included in this chapter. The policy should include procedures as well as assignment of responsibilities. The responsibilities for storage and updating of design engineers instructions for operation and maintenance should be assigned. These instructions may contain a general strategy for inspection and maintenance of particular structures or facilities. If not included in the design engineers instructions, the general strategy for maintenance of particular structures should be completed and updated by assigned maintenance personnel and included in Section B of this chapter along with design engineers instructions.

B. SPECIFIC MAINTENANCE PROCEDURES

This section should contain details of strategies, policies, standards, procedures, record management provisions, and other information specific to the maintenance of each system element or group of elements. The listing contained herein is for guidance purposes only and is not exhaustive. Other categorization may be more appropriate for specific projects.

Given below is a summary of some of the more important maintenance aspects of these various features. To obtain additional information and details and for a broader and more thorough discussion, the reader should

research other reference sources. In some cases, equipment maintenance manuals for a specific project, or recommendations and literature from the manufacturer of specific components, will provide a handy reference.

To assist the user in locating additional information and details, a numbered list of references is referred to throughout the section to be of further benefit to the user. However, the references are not necessarily a comprehensive list and other sources should be researched, especially those dealing with the site specific conditions of the country and project.

(a) Dams and Reservoirs

Since the planning, design, operation and maintenance of dams and other large structures is a highly specialized activity, irrigation agencies responsible for such facilities should refer to procedures and directions developed by ICOLD and its National Committees, and specialist organizations within the country. The use of external review panels at intervals not exceeding 5 years is generally necessary to support "in-house" activity.

The following listing of the problems and hazards which must be addressed in the maintenance of storage reservoirs is included to assist in these discussions:

- o sedimentation and siltation;
- o water quality;
- o bank erosion and slope instability;
- o vegetation control; and
- o recreational hazards.

Work plans will include programs for:

- monitoring
- catchment erosion control
- control of pollution sources
- bank protection
- acquisition of land
- vegetation control

Dams for irrigation projects are usually constructed of concrete, earth, rockfill or a combination of these materials. They should be inspected periodically for evidence of:

- o stress and strain;
- o instability;
- o abnormal seepage;

- o erosion;
- o possible undermining of the downstream toe;
- o foundation damage;
- o concrete deterioration; and
- o other possible endangerments.

Work plans will include programs for:

- concrete refurbishment
- gate maintenance
- seepage control
- foundation grouting
- rip-rap replacement
- maintenance of control facilities

Sufficient monitoring should be included in the work plan to determine the extent, the cause, the rate of deterioration, and the short and long-term effects of the problem. In addition, dam safety policies developed and approved by the organization should be included. The provisions of the policy should be applied to each structure systematically. A broader discussion and additional details are provided in references [3], [12], [20], [51], [55], [60], [68] [69] and [76].

(b) Open Canals (Channels)

Canals are generally excavated in earth or soft rock and may be either lined or unlined. Items to be considered in their maintenance are:

- o erosion of bed and banks;
- o damage to banks from human and animal activities
- o settlement and sloughing;
- o silting;
- o vegetation; and
- o seepage;
- o lining
- o sealants
- o under drainage

Work plans will include programs of:

- monitoring
- canal straightening, realignment
- bank protection
- dredging, silt removal
- lining repair
- vegetation control (chemical or mechanical)
- seepage control

References [3], [13], [20], [23], [28-29], [31-32], [34], [48], [55], [59-61], [63], [68], [73] and [76] provide thorough discussions and additional details.

(c) Structures

Most structures associated with irrigation projects are utilized for the conveyance, regulation and control of water. They contain both structural and hydraulic features and are generally constructed of concrete, stone and brick masonry, timber, metal, and rock and rock gabions.

Structures associated with dams and reservoirs are:

- o spillways;
- o weirs;
- o sluiceways;
- o tunnels;
- o riparian outlet works;
- o power outlets;
- o irrigation canal outlets and headworks;
- o fishways; and
- o reservoir pumping stations.

Structures associated with open channels or drains may include:

- o headgates;
- o check drops;
- o turnouts;
- o syphons;

- o flumes;
- o road crossings;
- o silt traps;
- o wasteways;
- o pumping stations;
- o cross drainage structures;
- o drain inlets; and
- o water measurement structures.

Structures associated with pipe systems or buried pipe drains may include:

- o inlets;
- o outlets;
- o silt and sand traps;
- o standpipes
- o pressure relief/air inlet valves;
- o manholes;
- o crossings; and
- o pumping stations.

Problems associated with these structures and their maintenance and repair requirements are generally similar. General maintenance due to age, natural attrition, and design or construction inadequacies are important. Additional details are provided in references [3], [20], [28], [31], [48], [55], [63], [68], [76].

(d) Pipe Systems

In pipe distribution systems the maintenance of not only the conduits must be considered, but also the many appurtenances such as gates, valves, metering devices, etc. The maintenance of some of these items such as pumps, motors, electrical controls and automation, are discussed later. Problems include:

- o damage to linings and coatings
- o corrosion;

- o separation of pipe joints; and
- o build up of material in the pipe and appurtenances.

Work plans will include programs for:

- monitoring
- cathodic protection
- cleaning
- joint repair
- lining refurbishment

Additional details are found in references [3], [4], [34], [35], [76].

(e) Open Drains

Drains generally suffer rapid deterioration in condition affecting performance levels, and require comprehensive maintenance programs. Problems may include:

- o erosion;
- o settlement;
- o sloughing;
- o siltation;
- o vegetation; and
- o seepage.

Additional detail is provided in references [1], [3], [5], [20], [23], [28], [32], [60-61], [68], [73], [76].

(f) Buried (Pipe) Drains

The major problems requiring maintenance include:

- o physical blockages;
- o organic or biological blockages;
- o chemical or mineral sealing and outlet restrictions.

Work plans will include:

- monitoring;
- cleaning;
- root removal;
- cleaning and repair of outlet grills.

Additional information on maintenance of subsurface drainage systems can be found in References [3], [24], [29], [56], [74], [76].

(g) Flood Protection Embankments

Flood protection embankments are facilities not normally required to perform their function on a day-to-day basis. However, there is generally little opportunity to carry out routine maintenance during periods of flooding.

In these circumstances maintenance programs should be implemented to ensure the facilities are fully serviceable prior to flood periods. Items to be considered include:

- o erosion and slumping of banks
- o rip-rap protection
- o damage to banks from human and animal traffic
- o vegetation and tree-growth on banks
- o bank cracking and seepage at structures
- o erosion and structures
- o control and cross drainage structures
- o access roadways
- o flood warning systems

(h) Roads

Roads located within an irrigation project and usually adjacent to a canal require maintenance to allow access to project features by operation and maintenance equipment and personnel. Types of roads associated with irrigation systems include:

- o all-weather paved roads;
- o unsurfaced or gravelled roads; and
- o berm roads along canals and drains.

Work plans will include

- grading;
- gravelling on the surface maintenance;
- slope protection;
- culvert and bridge maintenance

See references [3], [55], and [68].

(i) Pumping Stations and Electric Power Facilities

Pumps, motors, pumping stations, and electric power facilities are used extensively in irrigation and drainage projects in areas such as:

- o motorized operation and automation of structure flow control devices;
- o sprinkler irrigation systems;
- o computerized management facilities;
- o pumping stations for pipeline distribution systems;
- o pumped drainage;
- o pumpwells; and
- o transformers, switchgear (often maintained by the power utility).

The equipment is generally specialized and comprehensive specific instructions on care and maintenance are required, together with specialized training for maintenance personnel.

Specific care and maintenance procedures for each individual piece of equipment are usually described in the bulletins, manuals, and instructions furnished by the manufacturer. These should be included in the manual. An adequate supply of commonly used spare parts should always be kept on hand to ensure continuous operation.

For additional information see References as indicated.

- o for pumping stations, references [3], [20], [26], [30], [45] and [72]
- o for electric power facilities references [3], [30], and [45].

(j) Irrigation Wells

Maintenance of irrigation wells is primarily concerned with alleviating deposit build-up in and around the well screen and pump (incrustation) and preventing or slowing the rate of corrosion deterioration of the pump, screen, and well casing.

After installation, regular maintenance of the well is required to obtain satisfactory performance and extended life. Monitoring of the well discharge rate, draw-down rate and water quality is very important in detecting problems before they progress to a point where the well must be abandoned. See References [4], [20], and [43] for additional information on maintenance procedures and the control of corrosion and incrustation.

In addition to monitoring, work plans will include programs for:

- hydraulic flushing;
- chemical treatment;
- pump maintenance.

(k) Cathodic Protection and Protective Coatings

The protection from corrosion of buried pipelines and appurtenances, and exposed metalwork generally is a highly specialized activity.

However, the direct financial losses and loss in operational effectiveness caused by shortened service lives of fixtures and equipment due to corrosion and cathodic attack are substantial.

They are significant enough in most projects to warrant a specialist officer, or unit, to be assigned the responsibility for developing relevant maintenance and preventative programs for all of the project facilities and components likely to be affected.

These programs will be incorporated in the relevant Work Plans across the organization.

(l) Communications and Sensing Equipment, Radio Links, Remote Monitors

The maintenance of equipment in these categories is also a highly specialized activity, generally requiring a specialist officer or unit to be established to have responsibility for developing maintenance programs across the organization.

Where the opportunity exists, it is generally advantageous to enter into period service contracts with specialist firms or suppliers.

Routine maintenance procedures to be carried out by internal personnel should be developed from the manufacturer's manuals, and incorporated in the Work Plans for the relevant units.

(m) On-Farm Irrigation Systems

Most irrigation organizations do not have responsibilities for maintenance of on-farm systems. The following brief discussion is included for completeness.

Various types of on-farm irrigation have vastly different maintenance problems. Sprinkler [References 37, 45 and 46] and Localized Systems (drip/trickle) [References 10, 22, 27 and 34] offer special maintenance problems, and the listed references provide guidelines for their solution.

(n) Sewage Effluent Irrigation Systems

The design of irrigation systems for disposal of sewage effluent requires special considerations. However, even properly designed systems may have additional or increased maintenance problems as compared to conventional systems. Because of the higher content of organic and inorganic chemicals, sewage can be quite corrosive. In addition, sewage effluent may contain suspended solids which can build up in pipelines, and clog valves, emitters, and sprinkler nozzles. Additional information on effluent irrigation can be obtained from Reference 34.

(o) Equipment, Buildings and Other Facilities

An organization may require a wide range of assets from computers to buildings which must be operated and maintained efficiently and effectively. Each type of asset will have different problems and unique elements in the maintenance work plan.

CHAPTER 5: ADMINISTRATION

A. GENERAL

Project management entails the application, direction and control of project resources to achieve the objectives of the entity. Obviously, the effectiveness and efficiency of project management depends on the quality of staff, adequacy of facilities, equipment and funds, the institutional arrangements and the timely flow of management information.

The primary institutional aspects are addressed in **Chapter 2** with the facilities and other matters treated in **Chapter 1**. Aspects of administration, one of the functions noted in **Chapter 2** is detailed further in this chapter. Programming and budget matters will be treated in **Chapter 7**.

The administration function provides the essential support to project management, and the dominant project functions - operations and maintenance. The following fundamental elements of administration will be addressed:

- o Management information systems
- o Personnel functions and responsibilities
- o Stores procurement and inventory control
- o Financial procedures
- o Administrative support procedures

B. MANAGEMENT INFORMATION SYSTEMS

(a) General

Effective management depends on the timely flow of management data and information to assist in controlling the day-to-day activities of an enterprise, and to provide a basis for longer term review and evaluation of the progress of the organization towards achievement of its objectives.

Given the nature of an irrigation system, the interactions involved, and the wide-ranging implications which flow from the irrigation activity, there is usually a great deal of data and information collected by an irrigation agency with is of direct relevance to other organizations and landholders. In some cases, the irrigation agency is best placed to collect other information which is essential for effective performance of other agencies, e.g. land management agencies, agriculture departments and research institutions, core Government planning and budgetary departments.

A great deal of data and information needs to be collected, processed and presented in a form suitable for review and action by relevant managers and responsible officers throughout the organization, and to other relevant bodies.

Managing the flow of data and information is a critical activity for all organizations, and for optimum results, the processes need to be integrated across the organization. This is done by the design and maintenance of a Management Information System (MIS). Reference should be made to sections of this Guide under **PLANNING FRAMEWORK: - Para. B - INSTITUTIONAL PLANNING AND MANAGEMENT.**

The responsibility for operating and maintaining the MIS will be clearly identified, and it is usually designated with the Administration function. However, the design of the system must involve those managers and supervisors within the organization who need the information and will use it in the exercise of their individual management responsibilities.

(b) System Definition - Information Needs

The information needs for each organization are generally specific and must be clearly identified. However the following listing is indicative of likely requirements:

- o Management Reports
 - financial reports, expenditure against budget
 - costing reports
 - physical system status, - water availability, storage status
 - canal status
 - water deliveries
 - personnel status
 - maintenance program status
 - inventory control
 - plant availability
- o Statistical Reports
- o Annual Reports
- o Other information reports

For each of the various needs, procedures need to be established and promulgated covering:

- o Data to be collected, sources
- o Frequency and method of compilation

- o Content, timing and frequency of reports
- o Distribution of information
- o Staff participation and responsibilities

(c) Content, Timing and Frequency of Reports

The content, timing and frequency of reports will obviously differ according to the function concerned e.g. water control information will be required on a continuous basis, sometimes in a "real-time" mode, whereas some financial reports will be on a periodic basis.

For Management reports, these characteristics will vary, not only with function, but also with level of authority involved, e.g. A Board of Directors, or a Director-General will only be interested in water deliveries on a weekly basis, say, whereas the operations managers will be concerned to monitor activities on an hourly or daily basis.

Financial reports, involving manpower costing, should be compiled on the basis of a discrete pay-period, such as weekly or monthly, or multiples thereof.

For Management Reports, one useful criteria for the timing, content and frequency of reports is that these requirements should be determined such that the management level to which the report is directed should have time to take corrective action, if necessary, to the activities being reported on.

If such response is not possible, then the reports are more correctly classified as Information or Statistical Reports.

This distinction will be particularly important for manually compiled and operated MIS, to avoid excessive reporting effort for little productive result.

(d) Computer-Based MIS

With the advent of mini- and micro-computers of greatly increased power and capacity, the opportunity is arising to achieve significant improvements in the effectiveness of the MIS, and for achieving economies in staff time and costs.

Where communication facilities exist to provide low-cost data transmission links, it is possible to link a network of such computers throughout an organization, including regional and local offices.

Such networking also offers the possibility of managed, integrated data bases, and greatly improved internal communication processes.

Many of the design principles for a computer-based MIS remain similar to those for a manually compiled system, however many procedures necessarily will be different. When converting from a manual system, care should be taken in system design to take advantages of all the possibilities offered by the new technology, and not simply computerize existing manual processes. Such conversion should be in line with a strategy developed under the planning processes outlined in earlier sections of this guide - **PLANNING FRAMEWORK, PARA B, INSTITUTIONAL PLANNING AND MANAGEMENT.**

In maintaining the system, it will be necessary to develop procedures for:

- o Updating system description and facilities
 - hardware
 - software
 - data storage
 - printers and communication links
- o Controlling development of new or modified systems
- o Approval process for additional equipment
- o Costing of services to internal client units

While a computer-based MIS offers great flexibility and scope, the absence of computer facilities should not inhibit the development of an effective MIS based on manual techniques.

C. PERSONNEL FUNCTIONS AND RESPONSIBILITIES

(a) Scope of Personnel Function

Personnel functions and the related responsibilities are to be described in detail. Parent agency, or government-wide procedures that dictate project organization actions should be noted and included in this Chapter. Some of the functions to be described include:

- o Establishing personnel policies and procedures.
- o Development and review of organizational structure.
- o Setting staffing qualifications and levels of sub-units.
- o Preparing position descriptions.
- o Preparing candidate requirements.
- o Recruitment/evaluation.

- o Determining compensation and benefit levels.
- o Staff processing/orientation.
- o Staff development and succession planning.
- o Maintaining personnel files.
- o Payroll.
- o Staff termination.

Responsibilities for initiating, directing and executing each function will vary. For example, the project manager will likely have final review of the first seven, and personally direct items 1, 2 and 3. Other functional managers - operations and maintenance - will likely participate the first 7 and item 9 and have on-going responsibilities for 4, 5 and 6. The project administrative manager will participate in all, helping to execute the first 7 and direct the remaining.

(b) Personnel Policies

Staff recruitment, training, compensation, benefits, advancement, specialization, and field expenses are a few of the personnel policies to be described. These are to be written in terms for ready use by managers, staff, and the administrative unit. Policy formulation should be directed towards the objective of attracting capable people, providing for constant improvement and maintaining a highly skilled dedicated staff. Equally policies should facilitate identification of unresponsive, low producing and otherwise ineffective staff, and identify processes for performance improvement or removal from office.

(c) Personnel Procedures

Procedures necessary for executing the functions described under (a) in conformance with policies described under (b) must be set forth in a clear manner for guiding responsible staff in the executing of these activities. Procedures are to be set forth in terms of function area, objective, actions and the initiating, executing, participatory, review, and approval responsibilities as appropriate.

D. STORES PROCUREMENT AND INVENTORY CONTROL

(a) Acquisition Procedures

Typically, responsibilities for acquisition of essential items needed by the project organization is assigned to one sub-unit.

It in turn may submit requests to a centralized agency or government purchasing unit or it may procure them directly from outside sources. The outside sources may be in the private sector or from government purchasing unit or it may be in the private sector or from government or quasi government entities.

Clear procedures are to be formulated covering every action of the acquisition unit from receiving requests, through processing requests, sourcing items, business transaction, receiving items and transferring/releasing to the end user. Initiating, approval, executing and review/audit responsibilities are to be set forth. These procedures should ensure the disclosure and elimination of opportunities for actual or potential misappropriation of materials and equipment.

The classes of items to be acquired would include:

- o Equipment and spare parts
- o Materials
- o Supplies
- o Property
- o Support services - professional, maintenance, construction

The timely provision of stores and services is of fundamental significance in achieving the objectives of the operation and maintenance functions. The adopted procedures for acquisition and supply will be directed to that end, with automatic checks to monitor progress.

On the other hand, the end user needs to recognize the inescapable time commitments inherent in the supply process, which will vary for the different classes. The officers responsible for developing the POM and Maintenance Work Plans will need to take these into account when planning their programs.

This aspect is particularly important when overseas purchasing is involved - see also Chapter 7, Para F, "Foreign Exchange".

A typical flow chart for the acquisition process is included as Annex 3: Sheet 1 indicates typical supply period objectives, Sheet 2 indicates a typical process for an individual item.

(b) Custody Issue and Disposal

Procedures for the receipt, care and custody of stores and materials will be formulated. The matters to be dealt with include:

- o Inspection and receipt
- o Payment and accounting
- o Stores facilities - security
- central and local
- o Stores issues, imprest stores
- o Standard items - maximum and minimum holdings
- o Custodial responsibility

Procedures for disposal of unused or redundant items are also to be formulated. This, likewise should treat the same general classes of items listed in (a) above, together with procedures for the consequential financial adjustment, credits, write-offs etc.

(c) Responsibility for Project Services

It should be clarified whether or not project services i.e., water supply, drainage, electricity supply and waste handling would be handled by this unit.

Water contracts, water contract management, and the related financial matters would be under the responsibility of financial sub-unit with direct participation and support of the project operations unit.

E. FINANCIAL PROCEDURES

Most financial procedures are standardized in government or by the central management of large or parent institutions. The associated rules, regulations, and accounting standards will be followed. But, nevertheless, some tailoring to the project may be needed as well as supporting procedures where standard procedures do not apply. Procedures for authorizing staff who will have initiating, and approval responsibilities must be defined. A complete set of procedures must be prepared covering all financial actions. These procedures should make auditing efficient and ensure probity in managing the financial affairs of the organization. These include:

- o budget documentation
- o budget processing
- o drafts on funds
- o invoicing
- o receipts

- o revenue collection (if applicable)
- o deposits
- o accounting
- o payroll
- o personnel financial records

F. ADMINISTRATIVE SUPPORT PROCEDURES

Specific areas of support and the associated procedures are to be described in a manner that the line unit managers and staff will clearly know the support and means to secure it. These will also guide administrative staff in the execution of their responsibilities and related tasks. The actions required by all participants are to be described. Usual areas of support to be addressed include:

- o Travel
- o Office communications
- o Computer services
- o Meeting/conference facilities
- o Typing and clerical services
- o Records, correspondence files
- o Plan filing
- o Office equipment repairs
- o Office maintenance
- o Office supplies
- o Printing, reproduction
- o Media liaison

CHAPTER 6: WATER USERS

A. RELATIONSHIP BETWEEN PROJECT AND WATER USERS

This chapter of an O&M Manual should deal with the relationships between an irrigation agency and the water users. It should clarify the rights and obligations of each party which will depend on the adopted organizations, and the nature of the system supply arrangements, for example:

- o System controlled by farmers.
- o System controlled by government officials.
- o System with parts controlled by government officials, parts controlled by farmers.

Whatever the form of arrangements for system management, it is vital that the relationships between the irrigation agency and the users be clearly defined and understood to provide the best service to the users. Preferably they should be condensed in a small document or brochure and distributed to all users. The cooperation of users is essential to the successful operating and management of an irrigation project. While the irrigation agency has the responsibility for distribution of the water to individuals (or, in many cases to groups of water users) and to ensure the maintenance of the conveyance and distribution system, the farmers are responsible for the operation and maintenance of their own farm facilities and in some cases, of the system delivery from the project delivery point to the individual farms. Mutual understanding and cooperation is essential for effective overall management.

B. RIGHTS AND OBLIGATIONS OF WATER USERS

The rights of water users derive from the project policies discussed in **paragraph A of Chapter II**. However they should be explicitly presented in this section depending on the type of organization. User rights may also include:

- o participation in the election process of the representatives of water users.
- o access to other services provided by the agency.

The obligations of water users may include but are not limited to:

- o Implementation of approved cropping pattern.
- o Timely order of water and compliance with the scheduling for water delivery established by the agency.
- o Making best use of water on the farm with minimum of losses and without harm to other users.

- o Maintenance in "satisfactory" conditions of the part of the delivery system for which they have responsibility.
- o Cooperation with the agency in the works which are carried out for their own benefit (maintenance or improvement works).
- o Payment in due time of any land/water or other charges and levies.
- o Compliance with effluent water quality standards or criteria, limiting the use of toxic materials, etc.

C. OFFENCES AND PENALTIES

As discussed above, it is important that water users, and project employees as well, comply with their respective obligations. The most frequent offences by the water users and the resulting penalties should be spelled out and known by the water users to reduce their occurrence. They may include:

- o Abstraction of water without project authorization.
- o Non-compliance with approved irrigation schedule at farmers field level.
- o Non-execution of maintenance works which are under their responsibility.
- o Non-payment of water charges.
- o Acts of vandalism, damages to project facilities and harm to other users.

D. OTHER SERVICES

Besides the delivery of water, project farmers may benefit from other services from the project agency which may include:

- o technical assistance for on-farm water management and other activities.
- o delivery of inputs (fertilizer, pesticides, seeds etc).
- o execution of farming activities (ploughing, fertilizer treatments, etc).
- o financial assistance.

The rights and obligation of the farmers regarding those other services should be presented in a separate document since it is not an integral part of an O&M Manual.

CHAPTER 7: BUDGET DEVELOPMENT AND PROGRAMMING

A. GENERAL

The development of the budget is an important element in the planning and management process for any organization. The budget documents provide a forecast and express the commitment in financial terms, of the programs, works and activities the organization intends to carry out in the period under consideration, usually one financial year.

The approval of the budget will be given at Authority or Institutional level, and in many cases approval at Government level is also required, for all or part of the budget provisions. Accordingly the procedures discussed in this chapter may include necessary interaction at Government level. It is recognized that there are many privately managed irrigation projects where there is no formal Government involvement in the O&M of the distribution system. However, most of the principles outlined in this chapter are applicable to both private and Government projects.

A clear and concise presentation of the budget contents will assist consideration by the relevant authorities, and enhance the chances of a positive outcome for the organization. In this connection, it is absolutely imperative that the Budget request in any year is framed to meet the agreed objectives for the organization and in accordance with its policies and priorities. Moreover, many of the budget proposals will have financial implications which extend beyond one financial year, and individual budgets need to be framed in the context of the organization's longer term Financial Plan. Refer to **PLANNING FRAMEWORK, Paragraph B, Institutional Planning and Management, and Paragraph C, Annual Works Plans and Budgets.**

Once approved the budget provides the authorization and financial framework for work programs for the year.

(a) Coordination - Budget Development

The development of the budget will involve every unit in the organization. The coordination of the budget process is the ultimate responsibility of the nominated officer (Budget Coordinator), usually located within the Administration/Financial unit of the organization.

It will be this person's responsibility to develop and promulgate the procedures within the organization, which will be outlined further in this chapter. Where appropriate, these procedures must conform to those in context and timing set out by the central Government agency e.g. Treasury, Department of Management and Budget, Department of Finance.

(b) The Budgetary Cycle

There are a number of stages and discrete activities involved in the formulation, approval and implementation of a budget which are

followed on a year-to-year basis. Collectively they are generally referred to as the Budget Cycle. The following listing is indicative of typical activities:

Formulation of a Budget Request

- o Review and evaluation of previous budget performance
- o Determination of key issues and priorities - consultation with water users
- o Issue of budget guidelines to units
- o Development of budget requests by units - consultation with users
- o Aggregation of budget requests at organization level

Approval Process

- o Review and adjustment at
 - Management level
 - Authority level
 - Government level
- o Comparison of spending proposals with estimates of revenue
- o Approval of budgets

Implementation of Approved Budget

- o Notification of approved budgets to units
- o Adjustment (if necessary) of unit work plans and program
- o Implementation of approved plans and programs
- o Monitor and review, adjust plans and programs as necessary
- o Completion of programs, finalization of expenditure for period

B. BUDGET PROCEDURES

(a) Format and Timing

The budget cycle extends over three budget periods. The formulation and approval processes must be completed prior to the financial year to which they apply, and the final review and evaluation of budget performance can only be completed at the end of that year of implementation.

The formulation and approval period has fixed deadlines, often dictated by the Government budgetary and appropriation processes. Accordingly, the units in the organization will need to have a disciplined approach to this activity.

The responsible Budget Officer will set out the timetable for the budget formulation, specifying the dates by which the various stages will be completed. **ANNEX IV indicates a typical timetable; Sheet 1 shows Corporate Planning Program, Sheet 2 outlines the Budget formulation timetable.**

As the individual unit budget requests need to be aggregated and reviewed at organizational level, there will be a need for standard forms and documents to be developed, both to facilitate their original formulation within the individual units and the subsequent aggregation by the Budget Coordinator.

The Budget Coordinator will prepare the budget forms, and related instructions and specifications in consultation with the appropriate functional managers, and arrange for their distribution.

The specifications and instructions will cover:

- o Description of activity or program
- o Justification for activity e.g.:
- o relationship to objectives for particular functional responsibility
- o commitment by organization or Government
- o effect on service being provided
- o economic justification (if appropriate)
- o priority
- o whether a continuing or new activity

Scheduling of associated resource commitments, expressed ultimately in financial cost. Typical items are:

- o personnel
 - numbers and classification
 - wages and salary costs
 - related allowances and expenses
- o equipment and plant hire
- o supplies and materials
- o energy, fuel costs

- o pumping costs
- o technical service costs - internal, external
- o contract services
- o training
- o travel, within-country and external
- o administrative and general expenses
- o any other item of projected expenditure

The instructions will also provide advice on standardized costs to be used in estimating e.g.:

- o salary and wage rates
- o fuel, energy costs/unit
- o plant hire, hourly or daily rate
- o particular materials and supplies
- o inflationary factors (if applicable)

The estimates of costs and resource commitments will be drawn from the estimates set out in the various elements of the POM and associated work plans, as described in earlier chapters.

If the estimate applies to systems or parts of systems which are not fully operational, then the estimates will be made for the planning, design and construction phases as outlined in the introductory sections, "Formulation of POM", of this guide.

In some instances, an organization may also be involved in programs for new work or modernization, or additional functions funded separately from the O&M budget. In such cases, the budget documentation will provide for these estimates to be made separately from the O&M estimates.

(b) Implementation of Approved Budget - Budgetary Control

Once the budget has been approved the following actions will occur:

- o Budget Coordinator will advise organizational units of the approved budgetary allocations in each case.
- o Unit managers will adjust (if necessary) their work plans and programs to accord to approved allocation of funds.

- o Unit managers will forward revised estimates to Budget Coordinator, &
- o Budget Coordinator to monitor and provide periodic report on implementation.

The reports and reviews by the Budget Coordinator will conform to the specifications set out for the Management Information System (MIS) - refer to Chapter V - ADMINISTRATION, Paragraph B, for details.

C. FUNDING SOURCES - COST RECOVERY

(a) Measures for Cost Recovery

The National policies for funding O&M budgets will vary according to particular circumstances and Government economic and social objectives. In view of the long-term nature of investments in irrigation infrastructure, questions of inter-generational equity frequently arise.

The range of measures adopted (sometimes in combination) by which revenue is raised by, or provided to, an irrigation agency to meet its costs, include the following:

- o appropriations from Government taxation or other revenues
- o land/water lease or rental charges
- o crop levy on farm production
- o water charges on water users, related to all or part of costs of operation and maintenance of distribution facilities
- o water charges on users, based on full costs of project facilities, including depreciation and interest on loans
- o water pricing to achieve a stipulated economic Rate of Return based on the written down value of system assets

Irrespective of the particular measure or range of measures adopted, the cost of O&M and revenue to meet its cost will be brought into relative context for either pricing or policy review considerations. This will be done at one or more of the following levels:

- o Government level
- o Institution or agency level
- o Project level

(b) Funding Sources

Where the responsibility exists for cost-recovery programs at agency or project level, all revenue estimates and sources must be identified in the budget documentation.

Funding sources will include:

- o Federal entities
- o State entities
- o Provincial entities
- o Local entities
- o Landholders/lease holders
- o Water users
- o Other users or beneficiaries

D. FUNDING RELIABILITY

The costs associated with operating and maintaining an irrigation system contain fixed and variable costs. The nature of the enterprise is such that both fixed and variable costs are climate dependent, and frequently costs are incurred over which management has no control, and cannot be forecast e.g. droughts, floods. The need for maintenance effort can vary over the life of a project, depending on the age of the components relative to the anticipated service life.

On the other hand, it is possible for anticipated revenue to vary from "normal". If revenue is based on crop yields then periods of low revenue may occur due to poor yields or low prices. If revenue is based on the sale of the water, then the occurrence of droughts, or higher than normal rainfall reducing demand will result in lower than normal revenue, even though actual operating costs may be higher because of these abnormal circumstances.

The budget process normally requires forward estimates to be based on "normal" conditions, unless it is known otherwise with some certainty.

The requirements for O&M functions do not have the same order of possible fluctuations as revenue sources. It is not possible to drastically curtail these costs in a year, or a series of years, without affecting the performance of the system. Lower performance means higher costs and/or reduced capacity to earn income in the future.

Therefore, some underwriting of cash flows to an agency may be required to equalize revenue generation. This can be done by one or more of the following methods:

- o Advances from Government
- o Establishment of an Equalization Reserve Fund
- o Overdraft facilities

It would be expected that the operation of these funds would be equalized by returns in better than average seasons.

E. SPECIAL FUNDS

There may be circumstances for the establishment of Special Funds, or special arrangements to access additional funds in particular situations:

(a) Emergency or Contingency Funds

To provide for unexpected operating or maintenance costs during the course of a financial year, e.g. floods, failure of facilities.

(b) Replacement Funds

If future significant expenditures are anticipated to be required to replace project facilities, it may be appropriate to include depreciation components in current charges or revenue, and place these amounts in a "Replacement" account subject to established procedures.

(c) Construction, Rehabilitation and Modernization

If programs of this type exist, they may be funded by external funding, which could carry some interest or redemption charge. If so, these charges should be included in the budget estimates, together with reference to fund sources to meet them.

F. FOREIGN EXCHANGE

In some countries, problems of foreign exchange arise in funding procedures. Foreign exchange may be required for the purchase of equipment, materials, spare parts, for training or other activities.

In some cases the O&M organization may acquire its own allocation of foreign exchange under its direct control. More frequently, applications need to be made through an exchange control authority.

In any case, it is important to identify foreign exchange requirements well in advance of the actual procurements so that stores and other items can be replenished without creating shortages that adversely affect the timing and effectiveness of O&M activities.

G. WATER SERVICE CHARGES

The practice of prescribing a fee or royalty for water varies for individual countries. In some, no fee is charged for water extracted by an individual from wells or rivers for human or stock uses, in some cases such free access being enshrined in legislation. In others, a fee is collected for access to a nominated volume of water, e.g. for water rights.

In many countries, moves are now being made to differentiate between a fee or royalty as described above, and water charges. Water charges or water rates are raised on consumers or landholders to cover all or part of the costs of a water supply system, i.e. those costs associated with the collection, storage and/or extraction of water from a source, and its distribution to consumers through a network of streams, canals, pipelines or aquaducts.

Where all or part of the agency costs are met by water service charges, procedures will be established relative to the raising of the charge, its assessment and collection, and accounting procedures. Estimates of projected revenue raisings should be included in the budget documents.

Some of the factors involved are:

- o legal authority for charges or fees
- o class use of water e.g. gravity supply, relift, pumped diversion
- o basis of charge/area, volume, crop type
- o basis of assessment/measurement, estimation, formulae
- o additional charges - excess water use, special timing of delivery
- o drainage charge
- o basic service charge

CHAPTER 8: MONITORING AND EVALUATION

The monitoring and evaluation details required for projects vary considerably between irrigation and drainage projects. These details are most important to smooth long-term efficient system management and are critical in setting priorities for O&M and adjusting seasonal and yearly operational requirements.

These activities are most effective if carried out at two levels. Normally the on-going detailed monitoring and evaluation is assigned to one or more units. This unit (or units) is responsible for distribution of information from evaluations to appropriate managers that have need for the details. Another small unit typically carries out audits, both physical and financial, directly for the project manager's office to monitor and evaluate organizational performance. This chapter will deal primarily with the first activity.

A. MONITORING

Items to be monitored must be specifically noted. The organizational unit responsible for each monitoring activity must be identified. Details required in a monitoring plan include:

- o activities to be monitored, such as:
 - o precipitation and temperature;
 - o crop production (area, yields, types of crops);
 - o water quality;
 - o water use - farmers, municipal and industrial, others;
 - o groundwater quality and levels;
 - o return flows;
 - o drainage water quantity and quality;
 - o soil salinity;
 - o operating costs of major components such as:
 - individual pumping plants
 - main water supply
 - distribution blocks
 - o maintenance activities, schedule and costs for major components.
 - o data to be collected for each monitored item.

- o monitoring locations for each activity.
- o methods and procedures for each monitoring activity.
- o timing of monitoring actions.
- o data presentation, format, detail and storage.
- o distribution of information.

B. EVALUATIONS

Evaluations of information gathered in the monitoring process must also be systematically performed. The organization units responsible for evaluating data must be identified and assigned specific evaluation areas. General information which is needed for each type of evaluation will include:

- o data sources (from monitoring and other areas);
- o timing of evaluations.
- o methods to be used in making evaluations for each purpose;
- o format for the evaluations to be distributed including reports to be prepared reflecting the evaluation;
- o who will receive the reports and when?

C. PERFORMING EVALUATIONS

To manage a system properly the physical effectiveness of past operations must be considered against the original criteria set for the project, or as subsequently amended following modification of the facilities. Procedures for acting on the indicators uncovered in evaluations are critical to the financial and operational efficiencies of a system. Priorities for adjustments in the system and scheduling the needed maintenance can best be made using inputs from timely and proper evaluation reports. Some of the diagnostic analysis that can be considered are:

- o farmers operational performance
 - adequacy of crop production techniques for irrigated farming;
 - adequacy of irrigation methods;
 - farm management and economic results;
 - soil management and erosion control;
 - on-farm efficiency of water use.

- o delivery operational performance
 - water use efficiency for a distribution;
 - water losses (physical);
 - project overall water use efficiency;
 - deep percolation
 - canal seepage
 - spillage from canals
 - reservoir seepage
 - water operational losses
 - adequacy of delivery scheduling
 - energy use
- o drainage operational performance
 - drainage requirement change by area;
 - water table fluctuation by season and years;
 - water quality changes by area for drain effluents;
 - soil salinity changes by area;
- o maintenance of individual components
 - civil works
 - (1) canals
 - (2) structures
 - (3) drains
 - equipment degradation and prediction of replacement schedule:
 - (1) fixed (pumps, hoists etc.)
 - (2) moveable (earthmovers, transport vehicles, truck, loaders, etc.)
 - (3) computers and office equipment
- o Overall Project Review: Efficiency and Effectiveness. The Procedures outlined in Paragraphs (1) to (4) above will

evaluate the relative performance of various project components and activities, and should expose whether any poor performance is strictly a technical or managerial problem which may be resolved by internal management processes.

It may be necessary, from time to time, to carry out a more wide-ranging evaluation of the total project, for example, if poor performance is a result of inadequate flow of funds for O&M because of inadequate generation of benefits, or from external economic, social or environmental effects.

Some of the matters which should be canvassed in such a review are:

- documentation of project costs and revenues;
- adequacy of revenue sources to meet O&M needs;
- benefit flows from project to farmers; governments, others;
- comparison of benefits generated to revenue required;
- relevant agricultural and engineering issues;
- social and environmental changes and resulting implications;
- institutional effectiveness in providing efficient and effective system operation and services to water users.

ANNEX 1

GUIDE TO AUXILIARY DOCUMENTS:
PROJECT OPERATION AND MAINTENANCE

General

The Plan of Operation and Maintenance (POM) constitutes the comprehensive guide, detailed instruction, background information and documentation for operation and maintenance of a project. A description of the POM is provided in the introductory sections of the document, "Guide for Preparation of a Plan for Operation and Maintenance".

Besides the preparatory work by the O&M unit, several documents are to be prepared by other units in the irrigation agencies prior to commencing operation. These are to convey instructions and/or information to be incorporated into the POM with the complete documents serving as reference on the subject items. The documents include:

- (a) Project Feasibility Plan. The Project Planning document forms an important part of the O & M reference material. Of particular importance in addition to the report, are the policies, rules, regulations and legislation bearing on O&M. Water rights and allocations are examples. And, of course, the details of the adopted project services, farmer obligations, cost allocation, water charges, agency/farmer O&M responsibilities and all other project commitments are essential to this POM.
- (b) Designers' Criteria. The design unit is to prepare a comprehensive report stating criteria used in design of the facilities. These are to cover such matters as material characteristics, allowable stresses, allowable loadings, allowable loading conditions on and adjacent to structures, protective measures to be maintained effective, and surface drainage removal.
- (c) Designers' Instructions to O&M. The design unit is to prepare a comprehensive report clarifying the permissible operating conditions including start-up and shut-down of each individual facility, system sub-component and system. Permissible rates of filling and emptying specific canal reaches, siphons and pipelines are obvious examples. Rate of operation of gates and valves are another. Required compaction and shape of canal prisms to be maintained including cross-slope of road subgrade and road surfacing; inspection and performance of toe drains and bridge supports; and cautions when finding dampness at aqueduct abutments, concerns with surface drains and canal lining are yet other examples. This is an important document that the people who design, must complete at the time plans and specifications for construction are readied, since others cannot reconstitute these guides nor are O&M staff capable or responsible for developing them.

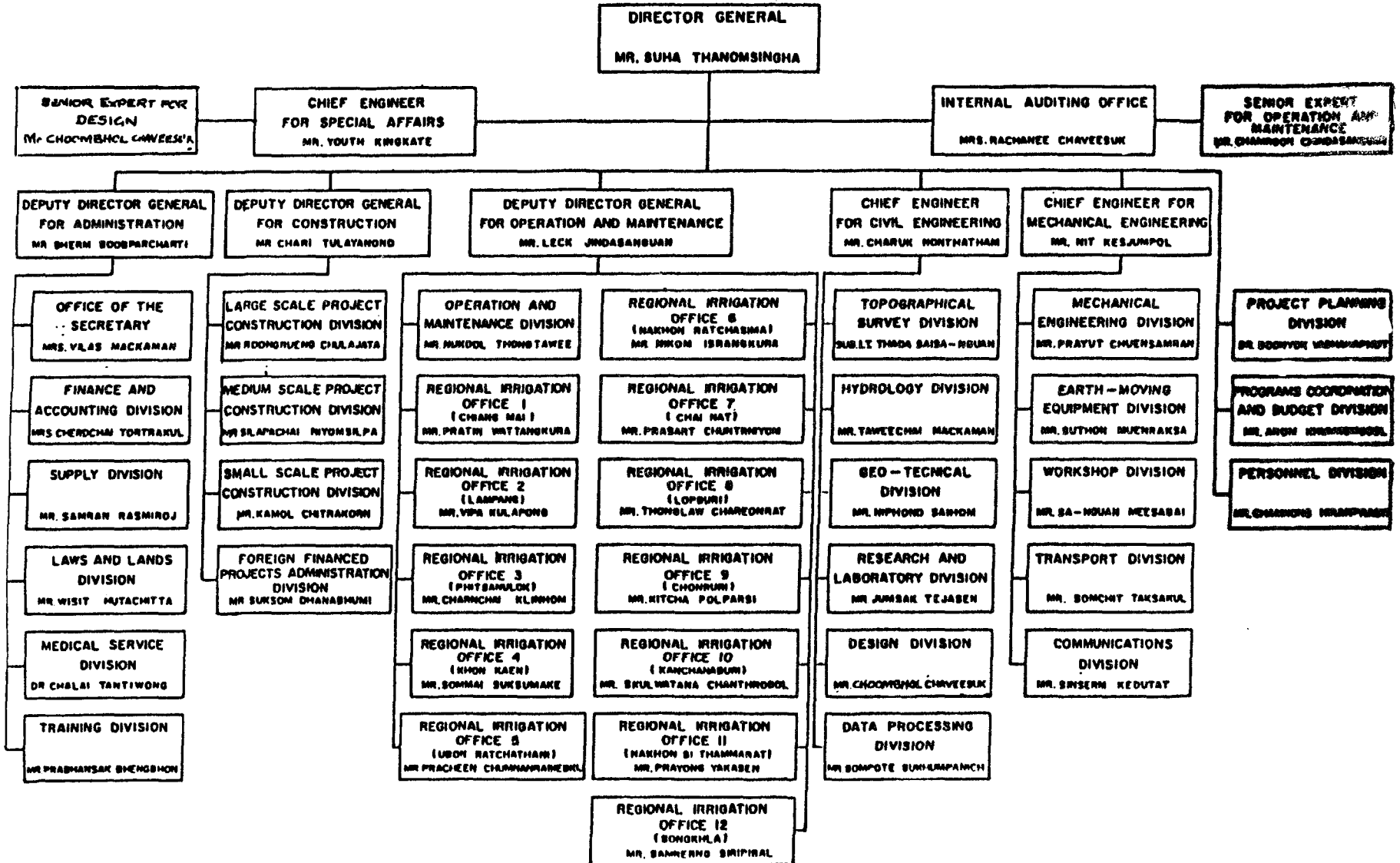
- (d) Right-of-Way Instructions for O&M. Maps of right-of-way and conditions for relocation of utilities are to be documented. Specific provision of access or other factors affecting O&M are to be stated.
- (e) Construction/Supply Contract Documents. Sets of drawings and specifications for all works should be furnished to the O&M unit at the time of tender. Subsequently, copies of change orders shall be sent when issued. These will form the initial basis for preparation of O&M manuals to be further refined using as-built drawings.
- (f) As-built Drawings and Manufacturers Instructions. As-built drawings should be completed by the design unit and forwarded to O&M within six months of acceptance of a project component from the contractor. These are essential for completing O&M manuals and procedures and their receipt should not be delayed until contract completion for large contracts nor until all components are finished. Likewise, manufacturers/suppliers warranties and instructions on equipment and materials should be provided as received.
- (g) Facilities Commissioning Procedures. Specific procedures for commissioning individual facilities, system sub-components and systems are to be stated. These are to include a description of acceptance tests, start-up procedures, measurements and remedy of deficiencies. The participation of representatives from the design, construction and O&M units are to be identified with responsibilities clearly stated. The Construction Unit should take the lead in preparing these with assistance from the other two-design and O&M.
- (h) Initial Complement of Equipment and Supplies. Though a part of POM, a separate document is required to be prepared by the Project O&M Unit together with the State O&M Office describing the necessary complement of fixed and moveable equipment and stock of supplies required at project start-up and at each subsequent stage of project development. This is required to allow timely budgeting, procurement and commissioning before the project services are to commence. Equipment is to include office, shop and field. Supplies are to meet like uses including one-year's spare parts, replacement components (filters, belts, etc.), lubricants etc. Usually, the project O&M unit is not staffed early enough to do this alone nor does it have funds to carry these start-up expenditures. It is a necessary part of the initial project investment and must be acknowledged and treated as such. It is assumed that offices, buildings, yards and lands are provided as a part of the usual project construction activity.

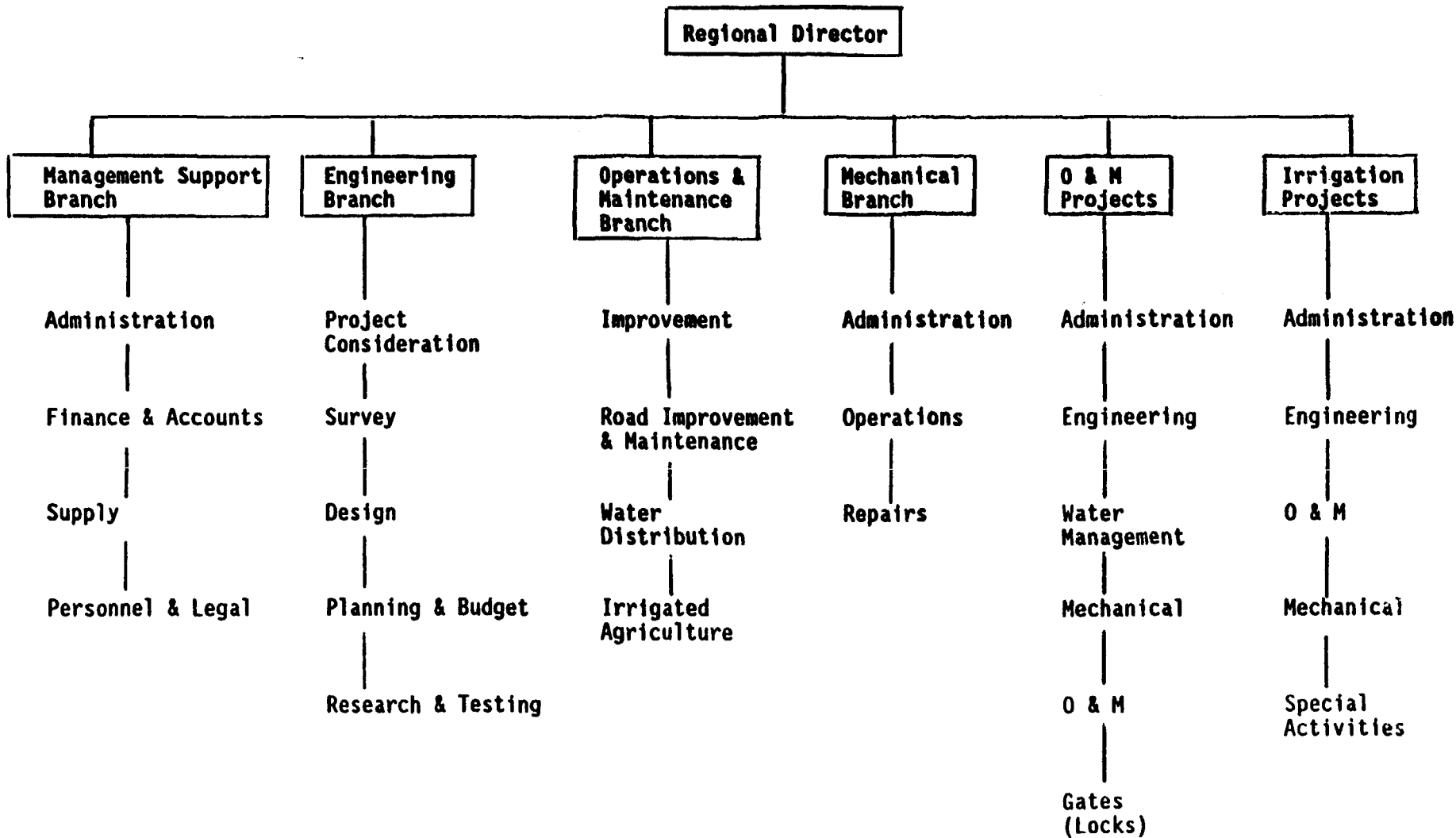
- (i) Initial Complement of Staff. Though a component of the POM, the initial two-years complement of staff noting specific numbers and qualifications are to be presented in a separate document. Required training courses and method of presentation are to be included. An essential part is the schedule showing recruitment, evaluation, placement, orientation and specific training activities. This must assure a fully capable staff in place at start-up that knows operation and maintenance of equipment, facilities and the systems. Funding and capability constraints necessitate that this also be a part of the initial project activity and investment. This document should be prepared by the State O&M Office.

ANNEX 2.1

ROYAL IRRIGATION DEPARTMENT, THAILAND

ORGANIZATION CHART
ROYAL IRRIGATION DEPARTMENT - MINISTRY OF AGRICULTURE AND COOPERATIVES





ROYAL IRRIGATION DEPARTMENT, THAILAND

Responsibilities and Functions of Regional Office
(12 No.)

Each Regional Irrigation Office is responsible for the operation, maintenance and improvement of irrigation projects; administration in finance, accounting and supply including some specific tasks under other Divisions in that particular Regional Irrigation Office area; co-ordination with other government agencies.

Each Region comprises four branches plus defined irrigation projects for O & M (135 in total). These are:

1. Management Support Branch
2. Engineering Branch
3. Operation and Maintenance Branch (small scale projects)
4. Mechanical Branch
5. Operation and Maintenance Projects (large projects)
6. Irrigation Projects

ANNEX 2.2

INDIA

NARMADA RIVER DEVELOPMENT - MADHYA PRADESH

NARMADA SAGAR DAM AND POWER COMPLEX

Institutions

General

1. The capacity of the institutions - organization, regulations, policies and most importantly, the capability of the people - determines the success of an undertaking by Government. The crucial role that the government institutions play in the success or failure of the development and management of the Narmada Basin resources was recognized early in the project formulation. An initial act was the creation of the Narmada Planning Agency (NPA) by GOMP. Assigned responsibility for planning the development of the basin, NPA concentrated on a basin-wide scheme of projects and the more detailed formulation of the Narmada Sagar Complex. Studies went forward on the dams and powerplant at the three sites; Narmada Sagar, Omkareshwar and Maheshwar, as well as the irrigation projects associated with the first two. This unit directed field and office work and the preparation of construction documents for early work at the Narmada Sagar. However, as work progressed, the need for expansion and tailoring of the organization to undertake the ongoing planning and the execution of the plan became evident. After discussions on the subject in the context of the goals MP had established for the basin development and of the programs to reach those goals; a plan of action evolved and major institutional changes were effected.

2. As a important step, GOMP created a basin authority, the Narmada Valley Development Authority (NVDA) in August 1985, with the responsibility for the planning, development and management of MP's share of the water in the basin and the lands and related resources directly affected. Units have been established to perform the various specialized functions in meeting these responsibilities. The immediate focus of the Authority's activities, which is the basin planning and the execution of the Narmada Sagar Complex, has permitted detailing the organizational arrangements to carry out the component tasks. Staffing plans, position descriptions, staff training and the use of consultants have been formulated reflecting the work, the organization and the capability of the staff anticipated to be available at the onset. These institutional arrangements, as bearing on the project, will be described in detail in this annex.

Narmada Valley Development Authority

3. The Authority was created by government order in July 1985. Patterned on authorities elsewhere in India and on similar organizations in

other countries, the entity has jurisdiction for all water resources and related development and management activities within the geographical bounds of the Narmada Basin in MP. To execute its assignment, the Authority has been granted administrative and financial powers somewhat larger than usually held by other departments in the government.

4. Overall responsibility for the basin activities and the direction of the Authority is vested in the Narmada Control Board (NCB) established by the same order. As a result, the Narmada Control Board will have close review and final approval for essentially all plans and actions proposed by the Authority. This board is chaired by the Chief Minister with the Vice Chairman being the Minister-In-Charge of the Narmada Valley Development Department. Members include the Ministers and Secretaries of GOMP departments involved in activities in the basin such as irrigation, environment, energy, public works, agriculture, forestry, finance and revenue. Other members include the Chairman, and Vice Chairman of NVDA.

5. The NVDA management consists of a Chairman; Vice Chairman; Members for planning, engineering, power and finance and ex-officio members which consist essentially of the various Secretaries of line departments involved in the basin. The chairman of the NVDA will be either the Secretary of the Narmada Development Department or an officer of the state government not below the rank of Additional Chief Secretary. All Members will be appointed by and serve at the pleasure of the state government.

6. Initially, the Chairman of the now abolished Narmada Planning Authority will serve as Chairman of the NVDA. This will assure continuity as the Authority commences operation. Likewise, all staff, functions and assets of the Narmada Planning Authority will be absorbed by the Narmada Valley Development Authority effective immediately.

7. The order states a number of functions that the Authority will be responsible for. Some of the most pertinent are summarized:

- (a) to prepare a detailed plan for exploitation of the water resources of the Narmada river and its tributaries and to undertake all necessary engineering works for the harnessing of basin waters for the purpose of irrigation, power and navigation and other development;
- (b) to undertake ancillary works for the distribution of water for irrigation, industrial, domestic and other purpose;
- (c) to undertake generation and sale of power in bulk to MPEB and provision of all necessary engineering works ancillary thereto;
- (d) to acquire and manage land in the valley for purposes of carrying out engineering works and provide for human resettlements and other activities to meet the needs for irrigation, flood control and navigation;
- (e) to shoulder responsibility for human resettlement and rehabilitation and to establish towns and villages and take all necessary measures to ensure planned settlement and rehabilitation;

- (f) to advise on the proper conservation and development of forest, wild life and fisheries in the valley;
- (g) to establish a design organization for the projects entrusted to it;
- (h) to undertake operation and maintenance of the projects; and
- (i) to undertake monitoring and evaluation.

Structure of NVDA

8. The organizational structure of NVDA is depicted in Figure 1. Offices are shown indicating the reporting responsibilities of the various functions. The Chairman, in addition to overall management of the Authority, has the immediate responsibility for and oversees the resettlement and rehabilitation program for the persons displaced by the construction of facilities. 1/ The Vice Chairman, in addition to his other duties, has direct responsibility for the resources council and administration. As may be seen on Figure 2, oversees the planning program of the Authority. The various specialized functions of the Authority below the Chairman and Vice Chairman come under the direct supervision of the four Members, consisting of power, engineering, planning and finance. The entire power activities from planning to construction and operation & maintenance report to the Member-Power. However, arrangements for coordination with the civil O&M activities, personnel, and maintenance services will be refined to assure effective and efficient management and operation of the project. All other planning will be carried out under the Member-Planning, who will receive support from the resources council and the power planning unit. The Member-Engineering will oversee design and construction of all civil works and minor mechanical/electrical works, pumping plants as well as the operation and maintenance of all Civil Hydro facilities. Member-Finance will oversee the the financial functions of the Authority.

Program Monitoring

9. As may be noted on Figure 1, and on the subsequent, more detailed charts of the sub-units, a program monitoring officer will be assigned in a staff position reporting to each unit chief. This individual will collect information as to the status of all activities in the unit. The items monitored will depend on the level of detail required by the unit management. These items will be displayed in reference to a CPM or PERT type chart, prepared by management and the various unit heads and documented by the program monitoring officer. It will be continuously updated by the program

1/ The organizational arrangements for resettlement, rehabilitation, soil conservation and afforestation are not discussed in this annex. They are described in detail in chapter 6 of the SAR of the "Narmada Sagar Area Development Project".

monitoring officer as information is provided to him by unit management and other sources.

10. Three important points relative to the program monitoring are emphasized:

- (a) All activities of the Authority including those relating to data collection, planning, design, construction, procurement, personnel recruitment, training, resettlement and funding which can be described as a series of tasks with completion dates will be defined and charted. Linkages to other programs will be identified on charts at every level;
- (b) The program monitoring officer will gather information and present status of programs at weekly intervals and on special requests. The status, potential deviations from schedule, and the cause of such deviation will be presented to unit managers at regular weekly meetings for their use in making decisions for adjusting staff, securing assistance, or altering the schedule;
- (c) The program monitoring, data storage and retrieval and the presentation of charts will be computerized. The selected system will permit management at any level to have access to this information on call. This will be particularly important once construction commences (first quarter 1986), when decisions will have to be made on modifying sequences of work or making adjustments due to unanticipated field conditions. The updated chart of the program monitoring office of each unit will be printed and forwarded to the next level of management above, on a routine basis; and
- (d) The program monitoring officer will exercise no management judgement nor will he have any responsibilities relative to decisions on remedial measures or alterations in the programs should delays arise. His sole role is the accurate, prompt reporting of all information and in that regard must be independent of the decision making unit.

11. It is absolutely essential for efficient, effective direction of the authorities that management at each level and its sub-unit heads expend the effort required to prepare a comprehensive, detailed, accurate program to begin with, and that program changes are promptly entered so it is current and accurately presents to management, at every level, the status of all activities. Program monitoring will be a critical element to facilitate proper management of the project, particularly recognizing its size, complexity and interrelationships and the time schedule which will be of great consequence financially, both from the standpoint of early generation of commercial power and avoidance of delays which will incur extra cost claims by the contractors and increase direct costs of Authority operations.

Planning

12. The Authority has primary responsibility for planning the development of the water resources and the related lands within the boundaries of the Narmada basin. Irrigation will be the dominant consumptive use and hence will have the primary impact on both resources. The resulting plan is to guide development through the delineation of the various physical projects and management programs - basin operations, water quality control measures, resources conservation, and the like. The plan is to document the goals and objectives adopted as the basis for the planning. Policies relating to the allocation and use of resources are to be established. The measures for evaluation of projects are to be clearly stated. Priorities of projects and programs are to be set forth.

13. Planning by its very nature will require updating of the basin plan at intervals as goals change, additional data is secured, and opportunities alter or new ones arise. The plan will have to be viewed as a guide reflecting both developments already committed and directions for the future. It must not become a crutch by which past decisions are blindly used as an excuse for undertaking or not modifying a certain project or for following a certain sequence.

14. The planning function by the Authority will, as a consequence, be an ongoing activity under the direction of the Vice Chairman and the Member-Planning. Figure 2 illustrates the inputs required from other primary units and indicates areas of expertise contained in the resources council.

15. The schedule for updating the existing plan is to be set, but the priority must be high in order to formulate the guidance and have it applied to both present and future activities. A comprehensive update concentrating on refining water availability and use by December 1986 would permit incorporation of the latest information into the planning of the subsequent phases of the Narmada Sagar Complex as well as guiding the project work in the mid and upper basin. A more comprehensive, detailed plan will be prepared by December 1987.

Design

16. As was shown in figure 1, the various areas of expertise and specialized capabilities to carry out the implementation functions of the Authority have been grouped into specific units. These units will have basin-wide authority and responsibility and will not be limited to individual projects, though initially their sole emphasis will be on the Narmada Sagar Complex.

17. The design unit, headquartered in Bhopal, will develop and maintain a staff capability to carry out the obligations of the Authority in the immediate programs for the Narmada Sagar Project, namely, design revisions augmenting the CWC/CEA support to be provided during the construction. It will also provide the design capability for dams, tunnels, powerplants, pumping plants and canals for the subsequent work, particularly Omkareshwar and Maheshwar which are the next components of the Narmada Sagar Complex.

18. Figure 3 presents the units comprising the design organization. Specialization into the categories noted will permit concentration and development of the high level expertise necessary and the consistent applications of high standards and most appropriate methods of analysis to all Authority design work. When technical questions arise or questions are posed by the field organization, the best talent in design can be readily identified and brought to bear.

Construction

19. The construction unit will have broad geographical responsibilities, though, as with the design unit, it will focus initially on the Complex. Figure 1 and Figures 4 through 6 present the organization. A headquarter's office in Bhopal will provide a direct link with the design unit on one hand and the operations and maintenance unit on the other. The construction unit's offices in Bhopal are shown on Figure 4. It's primary function will be to effectively manage all construction activities including the dam, the civil portion of the power plant and the canals, as well as, any ancillary work involved. It will assure the orderly combined procurement of government materials, the prompt delivery of those materials, the uniform treatment of claims and change orders, the review and control of contractor's payments and other related matters. An essential role will be overseeing and assuring that the field construction staff are properly trained and supported directly or through other means necessary so that quality, cost-effective construction can be assured through prompt and timely supervision and inspection. Another important activity in the Bhopal office of construction will be budgeting. This unit will prepare quarterly, annual and multi-year budgets reflecting actual and projected contract payments and purchase of government supplied materials. All procurement of materials and works will be centered in the Bhopal headquarters including prequalification, preparation of bid documents, bid evaluation and award. The legal expertise related to contract administration will be provided through the legal staff assigned to the Vice Chairman. These individuals will be specialized and experienced in construction and contract law related to heavy construction.

20. Beneath the headquarter's office, the next level of organization will be the field construction offices. Initially, the principal field office will be the one responsible for the construction of the Narmada Sagar dam and the power plant. Though these are two large undertakings, they are situated at one site and of necessity require a single field organization for the purposes of management and efficient use of resources and support. This field office will have subunits for the two primary activities--construction supervision of the power plant civil works and of the dam--both of which will be serviced by a single office engineering unit to handle quantities, payments, claims, change orders, and materials coordination; a technical support unit providing laboratories and geology; and the administrative assistance unit. Figure 5 presents the arrangement at the Narmada Sagar site.

21. A like unit, though less complex, having only one type of activity, will be established for the canal construction once it is to be launched. These organizations are depicted on Figure 6.

Operation and Maintenance

22. The operation and maintenance organization is depicted in Figure 7. Basin water operations involving forecasting, basin water allocation and instructions on operation of individual projects in the basin will be headquartered in Bhopal. Flood periods will require particularly close evaluation and direction of operations by the unit. Standards, procedures, personnel policies and related activities will also be carried out from the headquarter's office.

23. Units at the next level will be located in the individual projects. The level of staffing of these project offices will vary depending on the complexity as may be seen by the chart. The Narmada Sagar Complex will entail very major responsibilities and a substantial number of people. The field project office for the Narmada Sagar Complex O&M will consist of the three divisions noted and the various sub-divisions. The project document, Framework Guide for the Operation and Maintenance (see Schedule 3 in the main report), presents details on this organization. Staffing at every level in the O&M unit and all support facilities, both office and equipment are presented in that document.

24. The initial staffing will occur in the O&M office in Bhopal and though a chief may not be assigned immediately, activities will commence in 1986. Refining the operations plan, developing manuals and procedures, undertaking the development of the basin computer model for the purposes of water forecasting and "real-time" operations and importantly undertaking the immediate planning of the O&M facilities to be constructed under the project will receive first priority. Close coordination will obviously have to be maintained with both the design and construction units to assure a timely, efficient completion of O&M works so that they are available at the time of transfer of responsibility from the construction unit to the O&M unit.

Finance

25. The finance unit will essentially be as established in other government departments. The Member Finance will be the responsible individual in assisting management of the Authority with matters of finance. The units assigned to finance will include financial services.

26. Finance will set budget guidelines, compile unit budgets and prepare the annual budget of the Authority. Accounting, funding and disbursements will be the other primary activities. This unit will be responsible for securing and managing funds allocated by the state government for the execution of the Authority's programs.

Staff Position Descriptions

27. Staff position descriptions have been prepared for all of the key positions in the planning, design, construction and operation and maintenance units. Position description will be prepared by June 1986 for all positions required during the next two years, down through the level of assisting

engineers. These statements present the detailed description of the positions in terms of duties, responsibility and authority. Position qualification statements have also been prepared for key positions and likewise will be prepared for the others which present the training, experience, and management qualities required of the individuals that are to occupy these positions. Through the use of these two, a clear guide is provided to management for use in filling each slot. Six example position descriptions, an example statement of qualification requirements, and example support compiling data on candidates are presented in appendices _____ to _____.

28. It should be noted that many of the positions will demand individuals of substantial and specialized experience and training. Often, many requirements of a position will not be met initially by the individual assigned. An important use of the position descriptions and the qualification statements will be in comparing these with the credentials of the actual candidate and then determining the training and the consulting support that the individual will require. It will be on the basis of these actual needs that the final details and extent of the training program and the hiring of the consultants will be based so that they meet the situation as it evolves and that the staff training and assignment of consultants are carried out immediately when that need arises. This is an essential step that has been incorporated into the institutional arrangements for the project.

Staffing

29. Schedules of required staff will be prepared by unit chiefs and compiled in the personnel unit. Recruitment will commence well in advance of need allowing for change in employer, processing, orientation and training. Provision of additional personnel to allow for staff turn-over and initial inefficiencies will be made.

30. Staff will be recruited mainly from inside, but also from outside the COMP. Additional sources will be considered if vacancies remain. Evaluation of candidates' abilities will be made as applications are received or individuals are approached. The respective unit heads will participate with the personnel unit in the evaluation and selection of individuals particularly at the middle and higher levels. The staffing schedule for key positions is given in Schedule 2 of the main report.

Training

31. The training program will be refined as staff is selected and required courses are finalized. However, there are certain essential subjects that have been identified now. These include training in management and personnel as will be so important in these large units and several technical areas relating to both design and construction. A program has been developed for the initial use in budgeting and planning. This is shown as appendix _____.

32. The tentative training program was developed by training specialists from consulting organizations in India and representatives from the technical units in the Authority. This permitted incorporation of the views from both

the user and the training specialists. The program proposed is well thought out for this stage.

33. Trainers participating in this program will be selected to meet the specific needs, e.g., people with long experience in construction management or in field inspection will be used as trainers in those subjects rather than professors from the universities. At the same time, trainers in management and personnel will be selected both from management consulting organizations as well as universities. The technical consulting specialists described in the following section who will serve for periods of time in support of both design and construction staff, will also dedicate a portion of their time to the training program.

34. Coordination of the training and updating and refinement of the program as judged best from the results, will be under the direction of a full time training officer in the administrative services unit with advice from the supervisors of the respective technical units.

Consultants

35. The Central Water Commission (CWC) and the Central Electricity Authority (CEA) in Delhi have been serving as the primary consultants to MP for the design of the dam and power plant facilities in the complex. Their role, as consultant, will be continued during the construction period of Narmada Sagar dam and power plant. Staff in Delhi, augmented by individuals assigned to Bhopal, will provide the ongoing service.

36. It is recognized, however, that the Authority will have to support CWC/CEA in producing the 2-3,000 drawings which must be provided in the course of completing these two facilities, and therefore NVDA will have to greatly increase its capabilities. Consulting support to the Authority will be essential. Consideration was given to using a consulting firm in an overall lead role or in a support role for specific tasks. Consideration was also given to the assignment of consultants to work directly with Authority staff. These, however, would exercise no authority and have no responsibility for actions of NVDA staff. The prime purpose would be the transfer of technology and management skills. This latter approach has been adopted by the Authority and is the contemplated mechanism to be followed, assuming NVDA staffing goals can be met. Accordingly, resident consultant specialist positions have been identified for Bhopal and for the site. Other specialists are to be available on short-term notice to strengthen staff during the initial phases. The design consultants would also help support individuals who will subsequently be involved in the preliminary engineering on the Omkareshwar and Maheshwar facilities.

37. The primary areas where MP will be in need of strengthening their capacity is the management of the construction program. Contract administration, office engineering, field engineering and laboratory testing are examples where specialists will be required to augment the Authority staff.

38. The list of specialists and duration noted in para 3.32 and 3.34 of the main report are based on the best present estimates of support required by the Authority staff. Some position descriptions follow in appendices _____

to _____. The criteria for accepting the individuals will be based strictly on their qualifications and experience. Country of residence will not be a criterion. This level of consulting support will be incorporated into the program initially. However, as Authority staff are assigned to the positions and as the needs alter, this list will be modified.

39. Indeed the method of providing consulting support may have to be altered if the adopted approach does not yield the total capability required for NVDA to fully and efficiently carry out its assignment. Selection of the alternatives of assigning overall responsibility to a consulting firm may ever prove necessary to meet the essential needs. For the presently adopted method, definite advantages exist to have a consulting firm provide the individuals since the firm will assure responsibility for competence and can provide prompt back-up or replacements if needed.

40. Discussions were also held concerning immediate needs, particularly, that it may be necessary for GOMP to secure a consultant to advise on the detailed structure, procedures, manuals, and forms for the construction management organization. This, however, would be over and above the list of consultants. Likewise, the use of consultants to handle specific tasks in planning or design in order to maintain schedule is also assumed, but is not identified on the list.

Project Review Panel

41. NVDA will establish a "Project Review Panel" (PRP) for Narmada Sagar Project. The general scope of activities and experts is presented in the main report. The terms of reference presenting the specific responsibilities, the composition, the procedures and schedule for the establishment of the PRP are in appendix _____.

INDIA

NARMADA RIVER DEVELOPMENT -- MADHYA PRADESH

NARMADA SAGAR DAM AND POWER PROJECT

Terms of Reference - Project Review Panel

1. The Narmada Valley Development Authority (NVDA) will establish a Project Review Panel (PRP) and maintain it for the duration of the project until all facilities are placed in final operation.
2. The PRP will have the responsibility to examine the adequacy of investigations, design, quality control and construction of project facilities; to propose any modifications to ensure the safety and integrity of the facilities and to suggest measures that will enhance the usefulness and effectiveness of the project. The PRP will not be relied upon by NVDA to serve as technical advisor for optimizing design of the project or its components.
3. The PRP will identify existing and potential problems and make recommendations of remedial actions to NVDA and/or request NVDA to make available additional data or to carry out or cause to be carried out further studies to resolve questions.
4. The PRP will be headed by a chairman, assigned responsibility to coordinate PRP activities and to assure the objectivity and technical quality of its review and recommendations.
5. NVDA will be represented by the Member Engineering and the Member Power who will attend meetings, as appropriate; arrange for representation of NVDA engineering and construction units and consultants to participate in all meetings; provide data, information, analysis, studies, documents, plans and specifications etc., pertaining to the project; and secure such other materials, clarifications and relevant data requested by the PRP. NVDA will arrange the necessary logistical and administrative support to allow proper functioning of the PRP.
6. The Central Water Commission (CWC) shall attend meetings in these activities in strict accordance with its charge as central technical authority to monitor the implementation of the review panel's recommendations to the extent that the PRP recommendations pertain to dam safety. The only exception will be those instances when CWC is called upon to attend in its unrelated capacity as consultant to NVDA.

7. The PRP shall consist of a minimum of four permanent members, all highly regarded international experts with at least twenty-five years of active experience in the type of facilities comprising the project, at least ten of which shall have been in a position of final responsibility for the technical adequacy of works of the nature and magnitude comparable to the project. The fields of expertise in which the permanent members jointly shall possess high international reputation shall include:

- (a) design of large concrete dams and spillways;
- (b) design of hydropower plants;
- (c) design of large excavation and rock reinforcement;
- (d) construction management and methods for large concrete dams, powerplants and appurtenant works; and
- (e) geotechnical engineering.

All members shall be acceptable to the Bank. The criteria for membership cannot be compromised. At least two members will be from outside India. Any expertise of the qualifications stated that are not provided by the two outside experts and cannot be fully met by Indian nationals will be provided by securing the additional necessary members from outside India. No member may have been previously in the full-time employ of the Government of Madhya Pradesh.

8. NVDA will maintain a list of and arrangements with consultants and specialists having qualification standards equal to the PRP, identified by and acceptable to the PRP and the Bank that may be called upon on very short notice by the PRP to participate in its work. The fields of expertise to be provided by selected consultants and specialists shall include, but not be limited to:

- (a) design, fabrication and erection of gates, valves and hoists;
- (b) design and installation of instrumentation and control equipment for dams, plants and large rock cuts;
- (c) design, fabrication and erection of hydropower machinery and appurtenant equipment;
- (d) concrete design and placement;
- (e) materials testing;
- (f) operation and maintenance of dams, hydro power plants and related works; and
- (g) engineering geology.

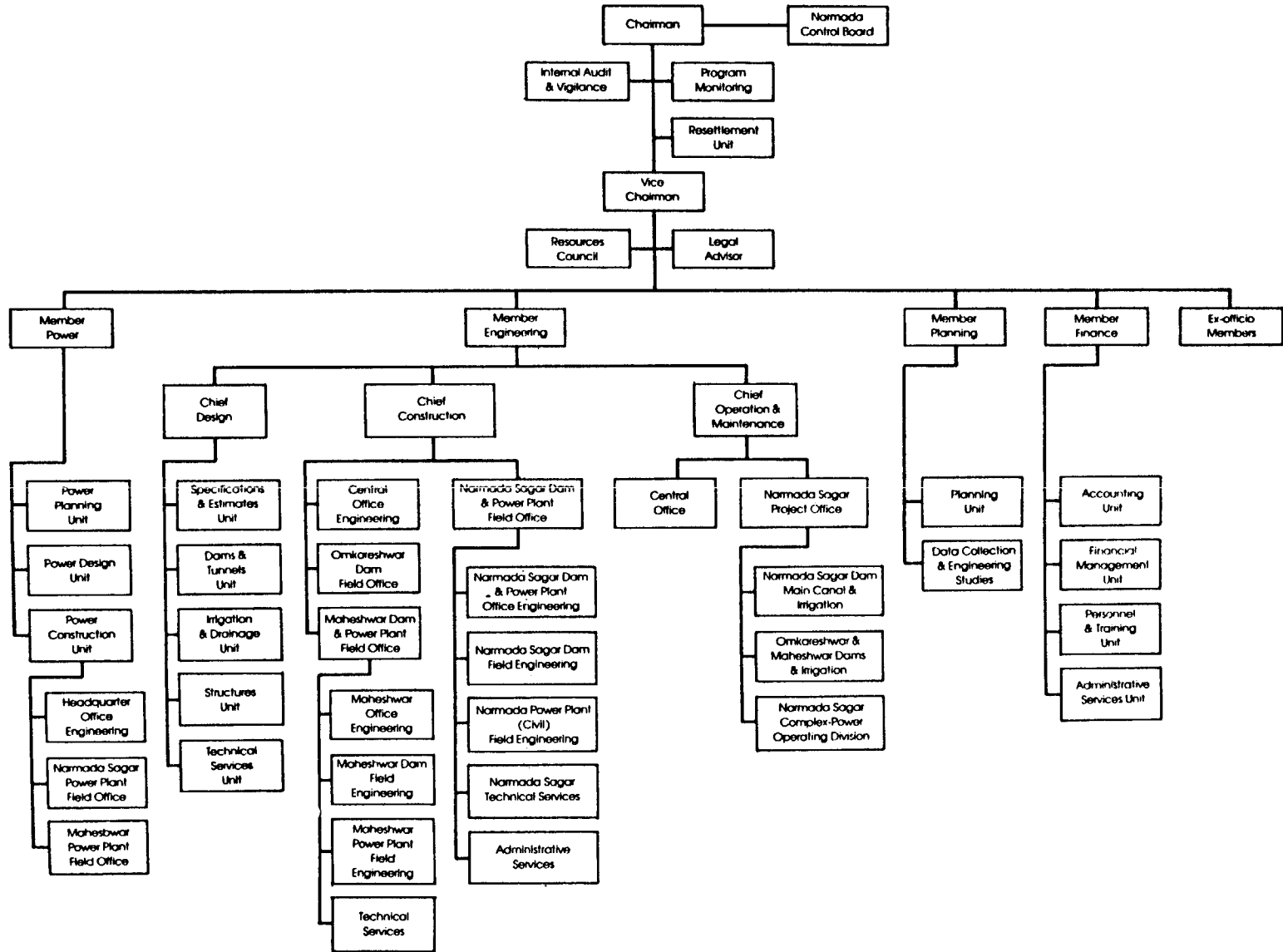
9. The list of consultants and specialists may be modified, added to or deleted at the initiative of the PRP in collaboration with NVDA following agreement with the Bank.
10. The PRP shall meet at times and frequencies that the PRP judges necessary to carry out its responsibilities or at the request of NVDA. A minimum of three meetings per year will be held during the initial three years and two meetings per year in the later phases. The PRP shall be free to engage consultants and experts from the established list (para 9) to assist it in the conduct of its work.
11. Meetings shall, in general, be held in the field or in the headquarters of NVDA, as judged best by the Chairman, PRP with all permanent members in attendance. Inspections by individual members shall be discouraged except under special circumstances. In such exceptional cases, the individual shall submit a report to the other PRP members; however, final recommendations on any issues shall be made jointly by the PRP at a meeting.
12. Meetings shall be scheduled in advance to the extent possible to facilitate logistics and the participation of Bank observers, if desired. Exceptions to advance scheduling shall be meetings judged by the Chairman or NVDA to be necessary on short notice due to special circumstances.
13. The PRP shall submit to NVDA a minimum of three copies of the minutes of its meetings immediately after the meeting is concluded. Within two weeks thereafter the PRP shall submit to NVDA three copies of its report of findings and recommendations and of the actions taken by NVDA on prior PRP recommendations. A copy of each document shall be forwarded by NVDA to the Bank and CWC immediately upon its receipt.
14. Whenever the PRP recommends changes or actions, NVDA will respond within two weeks to the Chairman, PRP and CWC with a copy to the Bank describing its decisions and actions taken. CWC will monitor execution of the actions in strict accordance with its role in safety of dams.
15. NVDA will exercise final decision on all matters, as provided within the established responsibilities respectively of state and central governments.
16. NVDA will establish the PRP no later than June 1, 1986 and convene its first meeting before August 1, 1986.
17. NVDA will make all arrangements for the list of consultants and specialists to be available to the PRP no later than November 1, 1986.

INDIA
NARMADA RIVER DEVELOPMENT - MADHYA PRADESH
NARMADA SAGAR DAM AND POWER PROJECT

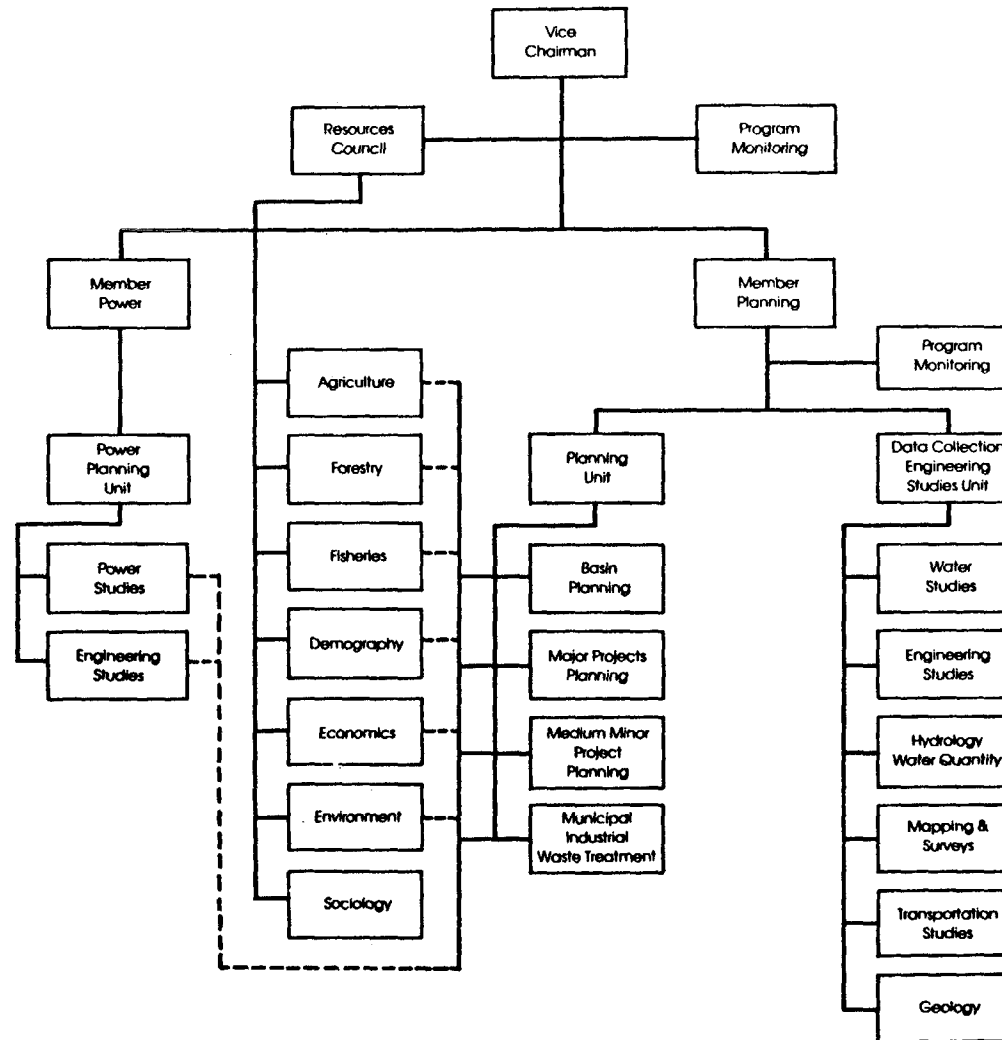
Training Program

SNO	Name of Course	Duration	No. per Session	Location	Instructor	1985				1986				1987				1988			
						Sr.	Middle	Jr.	Total	Sr.	Middle	Jr.	Total	Sr.	Middle	Jr.	Total	Sr.	Middle	Jr.	Total
1.	Project management (scheduling, budgeting, procurement & contract management)	2/3 wks	16	Delhi/Bhopal	IIPA	2	10	20	32	2	10	20	32	2	10	20	32	-	-	-	-
2.	Progress review & evaluation technique PERT/CPM	2/3 wks	16	Delhi/Bhopal	IIPA	2	10	20	32	2	10	20	32	2	10	20	32	-	-	-	-
3.	Construction mangut. Office engineering Field engineering	3 weeks			Consultant	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
4.	Quality control & lab procedures	3 weeks	15	Roorkee/Nasik	IIT/MERI	-	-	-	-	-	5	10	15	-	5	10	15	-	5	10	15
5.	Material management Inventory control	3 weeks	15	Bhopal	NPC	-	-	-	-	-	5	10	15	-	5	10	15	-	5	10	15
6.	Rock excavation - blasting procedure, safety measure, monitoring	3 weeks	15	Delhi/Bhopal	CWC/CMR I	-	5	10	15	-	5	10	15	-	5	10	15	-	-	-	-
7.	Mass concrete tech. mix design, mixing & transp. placing temp. control	3 weeks	16	Delhi/Nasik	CWC/MERI	-	-	-	-	2	10	20	32	2	10	20	32	2	10	20	32
8.	Design & drawing construction level					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
9.	Specification				Consul.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
10.	Planning, layout & design of water application system and drainage	3 weeks	5	Delhi/Bhopal	CWC/WALMI	-	-	-	-	-	2	8	10	-	2	8	10	-	2	8	10
11.	Engineering geology Geological investigations & foundation treatment.	10 days	6	Delhi	CWC	-	-	-	-	1	5	-	6	1	5	-	6	1	5	-	6
12.	Computer programming for design of canal & canal structures	3 weeks	5	Delhi	CWC/NIC	-	-	-	-	-	2	8	10	-	2	8	10	-	2	8	10
13.	Rock mechanics & stability of slopes & slope protection	10 days	15	Roorkee/Dhanbad	IIT/CMRI	-	-	-	-	1	4	10	15	1	4	10	15	1	4	10	15
14.	Relevance of environment in planning & execution of river valley projects	2 weeks	5	Delhi	CWC	2	3	-	5	-	-	-	-	-	-	-	-	-	-	-	
15.	Hydrology of small & medium catchment	3 weeks	15	Delhi	CWC	-	-	-	-	-	5	10	15	-	5	10	15	-	5	10	15
16.	Remote sensing & application	10 weeks	3	Delhi	IIT	-	1	2	3	-	1	2	3	-	-	-	-	-	-	-	
17.	Tunnelling	3 weeks	5	Delhi	CWC	-	2	3	5	-	2	3	5	-	2	3	5	-	-	-	

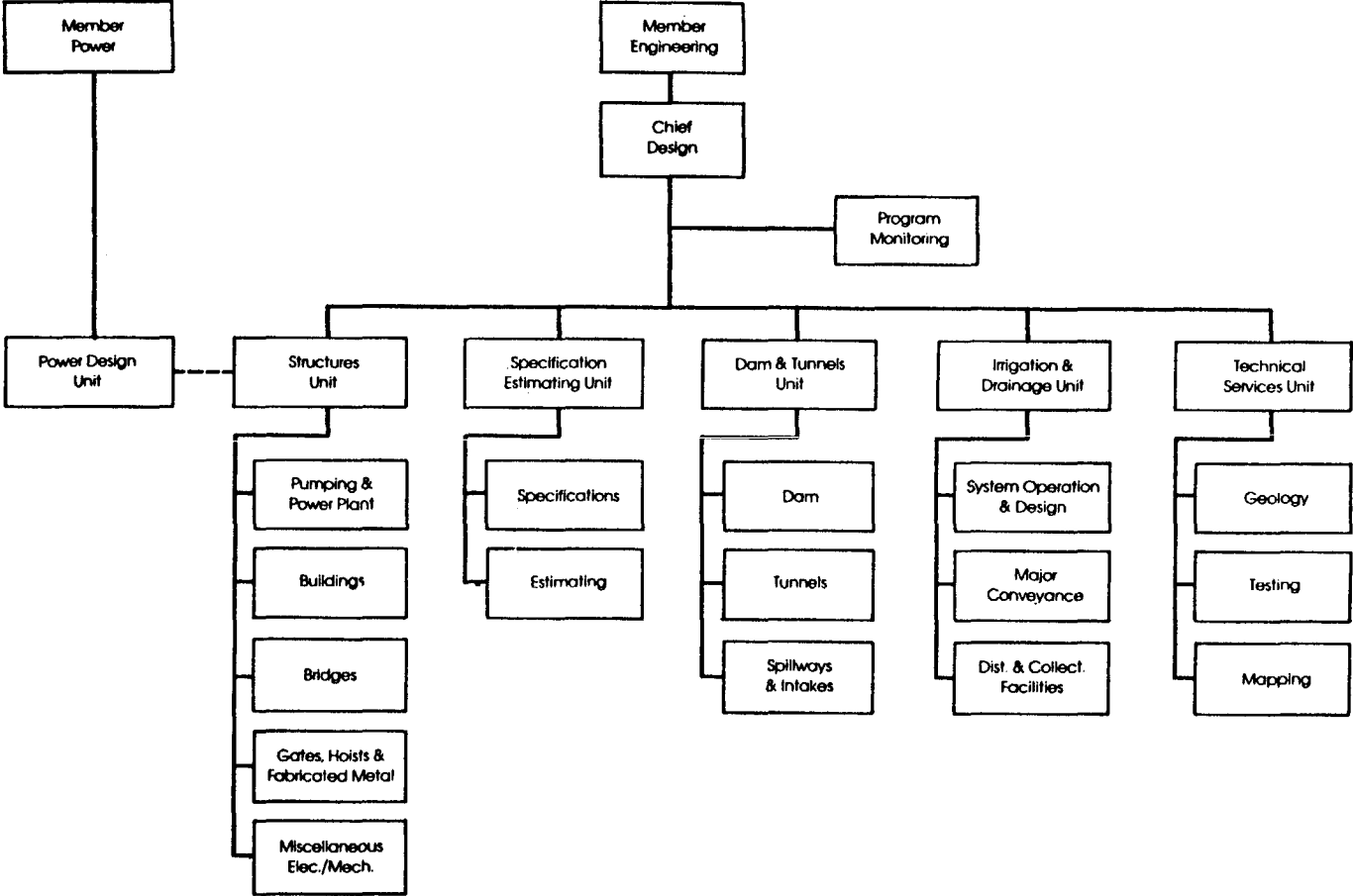
INDIA
Madhya Pradesh
Narmada Valley Development Authority
(Organization Chart)



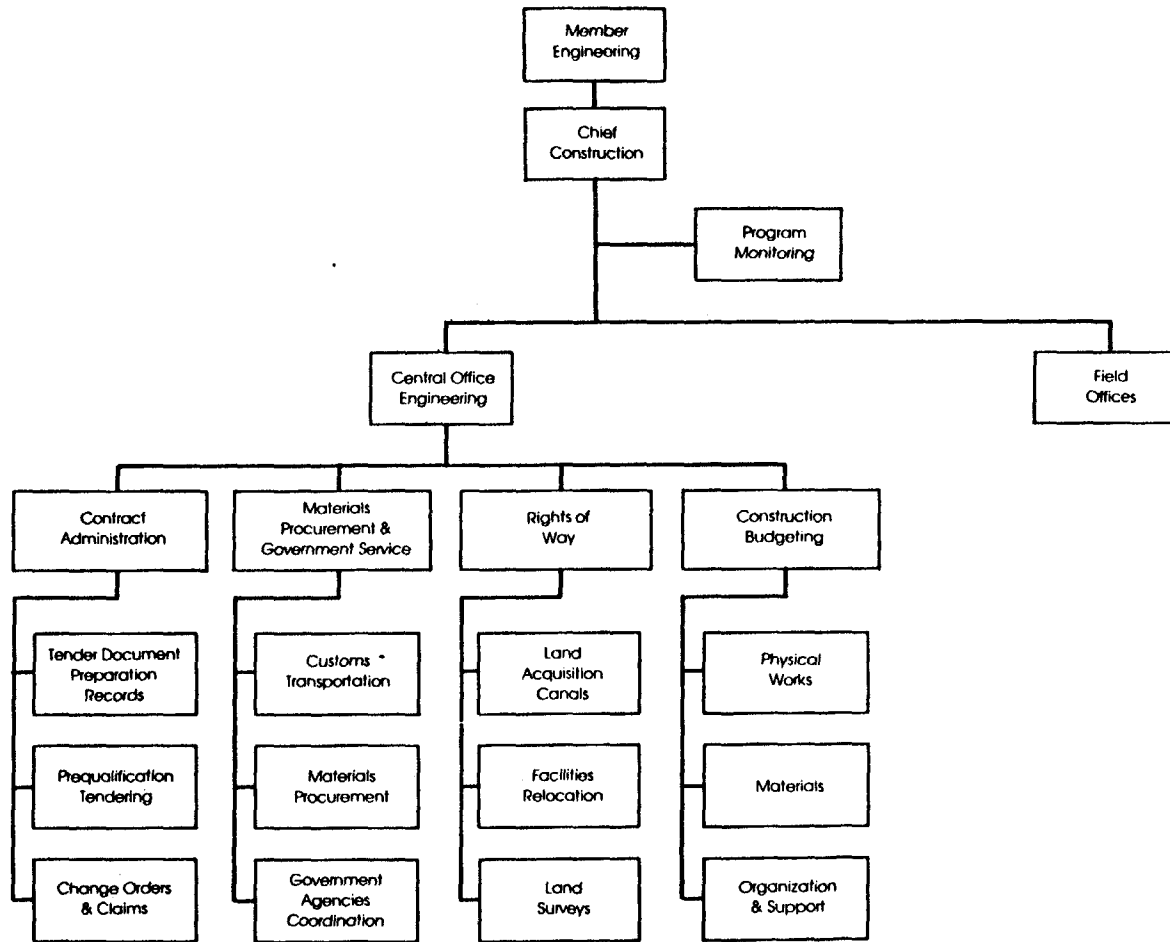
INDIA
 Madhya Pradesh
 Narmada Valley Development Authority
 (Organization for Planning)



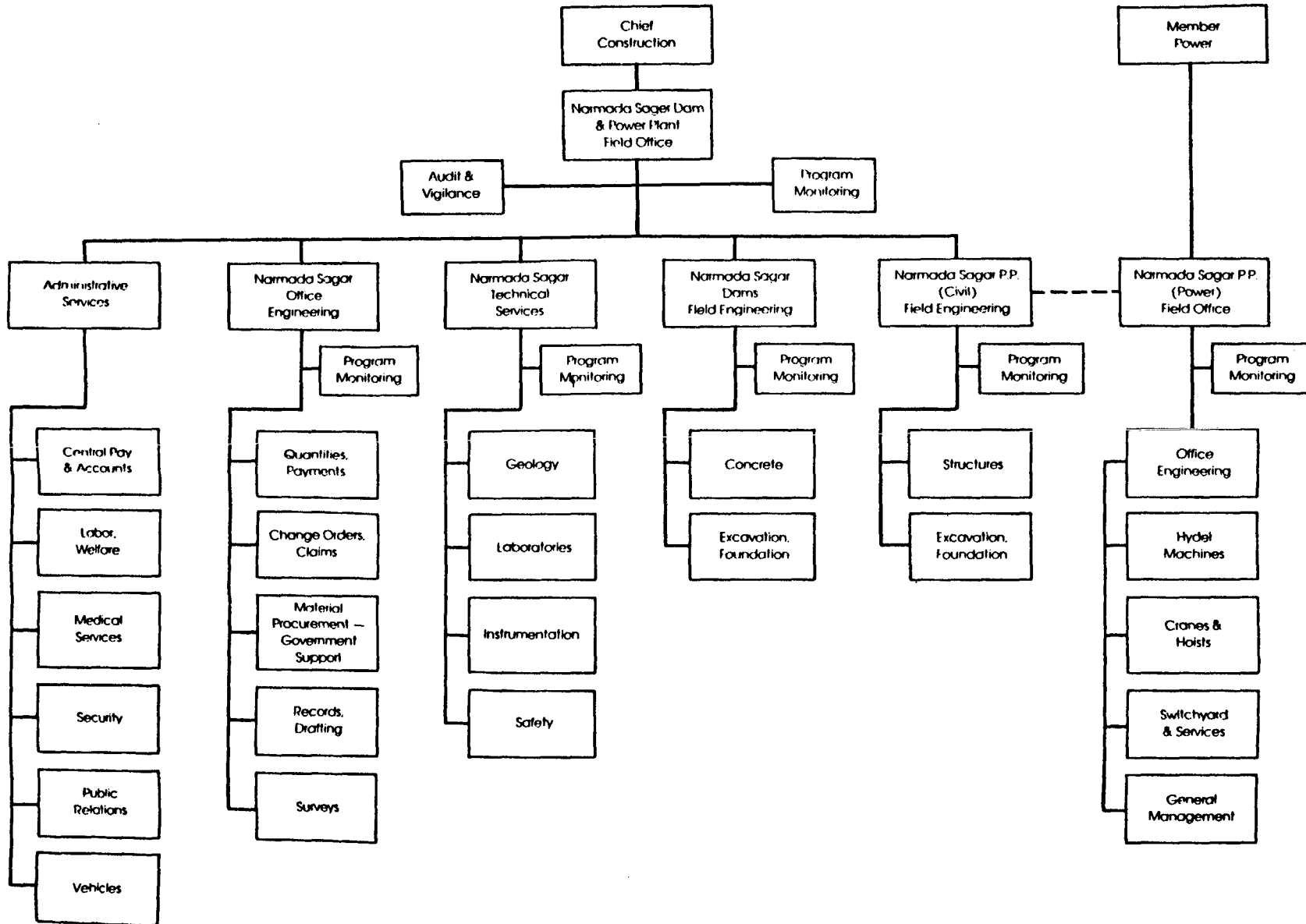
INDIA
 Madhya Pradesh
 Narmada Valley Development Authority
 (Organization for Design)



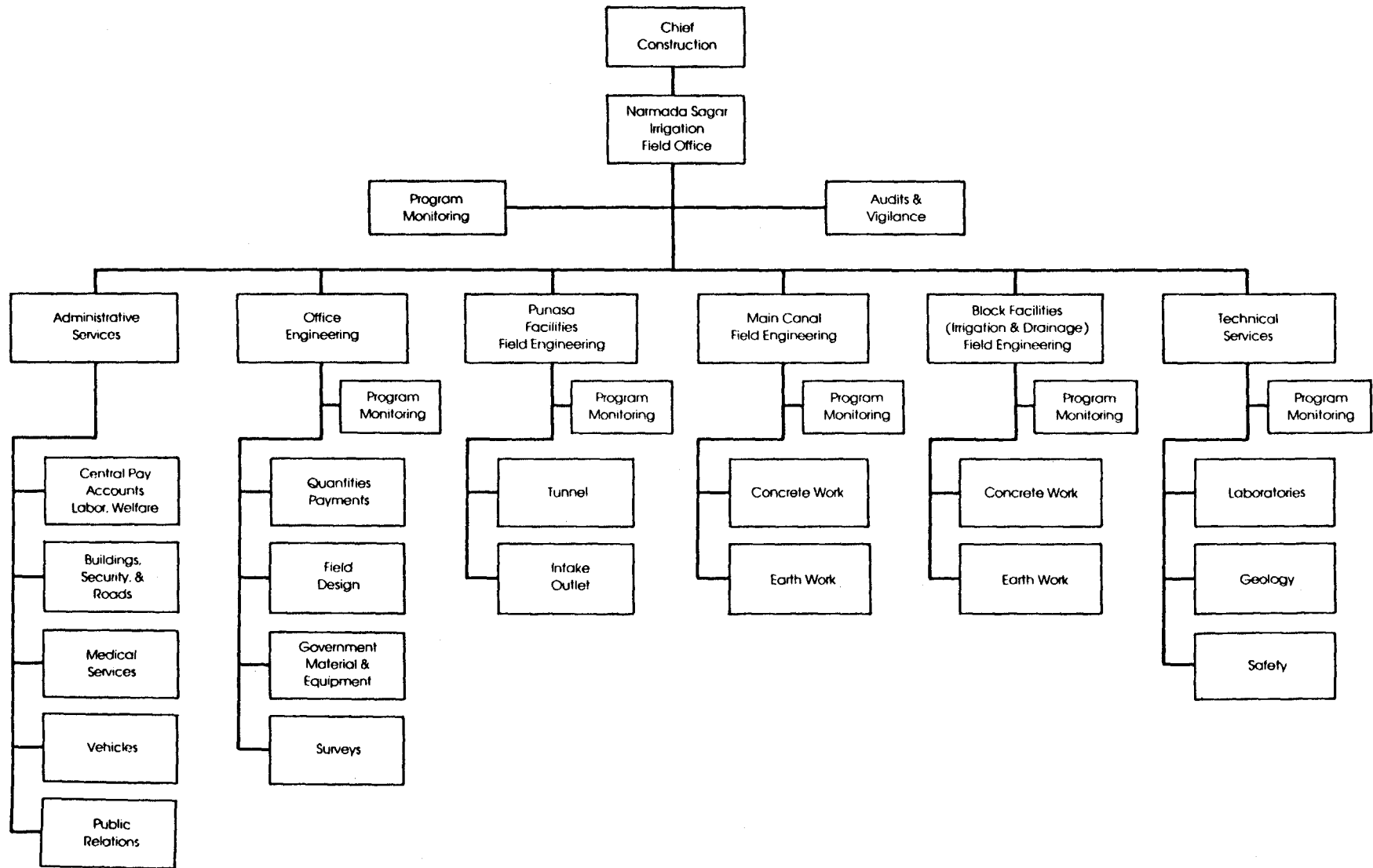
INDIA
 Madhya Pradesh
 Narmada Valley Development Authority
 (Civil Construction Organization in BHOPAL)



INDIA
 Madhya Pradesh
 Narmada Valley Development Authority
 (Construction Organization at Narmada Sager Dam Site)



INDIA
 Madhya Pradesh
 Narmada Valley Development Authority
 (Construction Organization at Irrigation Site)



INDIA

NARMADA RIVER DEVELOPMENT - MADHYA PRADESH

NARMADA SAGAR DAM AND POWER PROJECT

FRAMEWORK FOR OPERATION AND MAINTENANCE OF NARMADA SAGAR COMPLEX

A. GENERAL

1.01 The project is to be operated and maintained by the O&M office of the Narmada Valley Development Authority as a "utility". The sole function of this office is to provide a high quality service to its customers. Operation and maintenance (O&M) does not involve the activities of project planning, system design, or major construction. Neither is agricultural extension or "on-farm" development a function or a responsibility of the O&M staff.

1.02 Specifically, the primary objective of the O&M project is to furnish an adequate, reliable and equitably distributed supply of water to each farmer in the commands. The water will be delivered in a manner which assures greatest flexibility to the farmers at the least cost consistent with good service, long system life, and sound financial practice. Further, the project is to remove excess precipitation and control ground water levels to prevent detrimental effects on crop production and operate and maintain these drainage facilities in the same manner as the water delivery facilities. Thirdly, the project is to generate electricity utilizing scheduled and surplus water consistent with the governing policies and dispatching orders from the customer entity (MPEB).

1.03 The importance of these project objectives in the formulation, functioning and effectiveness of the O&M entity cannot be overstressed. A clear understanding and acknowledgement of the objectives are fundamental to the development of the organization. And it is essential for the staff to fully comprehend this in order to instill the necessary attitude.

1.04 Merely setting an objective is not enough. The motive and incentive to work towards meeting that objective must be built into the organizational structure and procedures. Contrary to the usual concept of irrigation and drainage agency O&M functions, the O&M role is "people" and "client service" oriented and not engineering or even technically oriented. This is not to say that many highly developed and educated engineering and technical skills are not necessary. They are essential. The focus of every highly successful irrigation and drainage project operation is on its function as a "service utility" to its clients. This basic philosophy, if strongly supported and

endorsed by the highest government levels, will produce an eminently successful project. Staff recognition, particularly by giving proper levels of compensation as provided in the other government utility, will attract and hold the staff which are key to success. With these the project staff will have, almost automatically, the motivation to do good work. They will take pride in their individual part in the progress being made and even more satisfaction in belonging to an organization, which serves millions of their fellow countrymen and serves them well.

1.05 Progress and achievement of the project in all areas is to be judged by the effectiveness and efficiency of the service the organization provides to support and benefit the farmer, and for strengthening of the power supply. In a very real sense, the project and all of its staff, particularly those engaged in system operation and maintenance, must be considered as partners with the farmers. When the farmers throughout the project area succeed and their situation is improved, the project succeeds. If there is no significant improvement in the condition of the farmers, both small and large, then the project has no basis for existence. The power customer likewise must be treated on an equal basis within policy and water delivery constraints. But since that customer is a strong, well established entity, there will be no difficulty in this respect. As a consequence, the more complex dealings with farmers will be stressed in this document.

1.06 The "Framework of Operation and Maintenance" of NSC Project has been drawn in conformity with the Project Criteria and Plan of Operation (Schedule A) and the above stated philosophy. It constitutes a documentation of O&M decisions and serves as a guide to the initial activities.

1.07 The documentation and arrangement for transfer of custody and responsibility for the physical works from the construction organization to the O&M organization will need to be worked out. However, the O&M activities start long before that.

B. SERVICE CHARGE

2.01 Modifications to current MP provisions for charging for irrigation services are under consideration. The different rates for different crops and the uniform statewide rate for a given crop regardless of reliability or adequacy of supply are but two of the features requiring review. For purposes of discussion and initial guidance on this matter, certain principles have been tentatively defined.

2.02 Charges for Authority services - water supply and drainage - will be assessed against owners of all lands within the project that are offered water supply. Class 6 and those Class 4 lands not served would not be assessed. The charges will be determined and computed for NSC independently of charges assessed on other projects in MP. The service charges to farmers constitute the total revenues from both the water supply and drainage function. As these are to fully cover all related O&M costs plus a component for capital recovery, the required annual totals will dictate the unit rates used to assess farmers for the service.

2.03 Since the water is provided in strict proportion to the farmer's irrigable land at unit delivery rates common for the entire project, the service charge will be based essentially on a volumetric measurement. However, no farm outlet measurements are needed for purposes of billing, and no variation in service or charge rates will be made to reflect different crops.

2.04 Actual volumes of water delivered to all farmers will vary year to year as dictated by the river supplies available. As a consequence, if charges are based on actually deliveries alone, the project O&M revenue would fluctuate widely, presenting severe difficulties.

2.05 The computation of charges to best meet project needs and recognizing the characteristics of service, will be 80% based on irrigable area and 20% based on water actually delivered using average annual volumes as reference. This also reflects that the drainage services can only be based on area of productive lands served, since measurement of actual annual benefits is not feasible.

C. ORGANIZATION FOR OPERATION AND MAINTENANCE OF NARMADA SAGAR COMPLEX

Structure.

3.01 Recognizing the type of facilities and relative ease of operation inherent in the canal distribution system as adopted in the Project Criteria and Plan of Operation, and having in mind a reasonable span of command at the various levels and offices, the project operation and maintenance organization has been structured as shown in figure 1. Figure 2 shows further breakdown of an irrigation division. In order of decreasing area or level of responsibility the units are the NVDA O&M office in Bhopal, project office, division, sub-division, section and service area (SA). The section does not exercise any administrative functions, but rather is used to designate a geographical area of responsibility for maintenance at a reasonable distance from the SAs and the farmers or covering a reasonable reach of the main canal. The SA will not belong to the O&M organization, but will be constituted of SA farmers and directed by them.

3.02 There will be three divisions--the Narmada Sagar Dam and Irrigation Division, the Omkareshwar and Maheshwar Dam and Irrigation Division and the NSC Power Division. By definition in the project criteria, the outlet to the SA is the terminus of normal irrigation operating responsibility of the Authority. If problems or conflicts arise within the SA hindering equality of service the Authority will, of course, take whatever action or play whatever role is necessary to assure proper operation. Otherwise, the farmers through their own organizations will operate the system below the SA turnout.

3.03 Figure 3 illustrates the composition of units in the irrigation service, both Authority and farmer directed and the approximate area within its jurisdiction. The following table presents area characteristics of the sub-divisions. Each section has five sub-divisions.

Characteristics of Proposed Irrigation Sub-divisions within Narmada Sagar

<u>Sub-division</u> <u>Sub-divisions</u>	<u>CCA/division</u> <u>(ha)</u>
A	22,000
B	22,000
C	24,000
D	25,000
E	25,000
F (Khargone lift)	23,000

- Note:
1. Narmada Sagar Dam and Irrigation Division would contain 8 sub-divisions; comprising one dam and power plant, one main canal and pumping plant, and six irrigation sub-divisions. The latter would have five sections and 75 to 100 SAs.
 2. Boundaries of the various sub-divisions will start with the determination of canal system location and SA boundaries and proceed by orderly grouping to the succeeding units. The figures shown above are only representative for use in O&M planning.

D. PROJECT UNITS AND KEY INTERRELATIONSHIPS

4.01 Units constituting the operation and maintenance entity will be described in varying detail. The units first discussed are those that provide the irrigation services. These will comprise the majority of the entire organization.

Service Area

4.02 SAs will be defined so far as possible by village boundaries as described in the project criteria, but delivery channel layout must control. Project water will be delivered to the SA through an offtake that will either be shut or open with the flow at a constant rate when open. Minor and sub-minor channels within the SA will convey water proportionately to chaks of approximately 50 ha size. Rotational use of the water furnished to the chak will be made to sub-chaks of about 10 ha each consisting of a single farm or several small farms.

4.03 Farmers within a chak will select one of their members to represent the chak on the Service Area Irrigation Committee (SAIC). It is suggested that following the initial organizational period the terms of chak representatives be staggered to provide continuity. Of primary importance will be the representatives' role in the determination of the SA seasonal irrigation

size and schedule. These tasks will be completed with the close help of the agricultural extension advisor assigned to the SA by the Department of Agriculture. The chak representative also will be responsible for scheduling water rotations and for arranging for channel operations and maintenance inside the chak. Payment of his services would probably be "in kind".

4.04 SAICs will meet monthly or more often if required. The SAIC Chairman will be selected by the SAIC members. He will be responsible for assuring the operation and maintenance of channels to be carried out by farmers ^{1/} within the SA and will have authority and responsibility to enforce committee decisions and project rules and regulations applicable within the SA. The SAIC Chairman also will be responsible for forwarding crop and water records for the SA to the project authority. In this task he will have the help of the agricultural extension advisor.

4.05 Water assessments collected by the sub-division will generally reflect both the charges to be remitted to the project and the charges incurred by the SAIC for SA O&M and administration. Delivery of full water allotment to the SA will be made only on payment of the SA's total water bill. Water deliveries will be reduced proportionately to the amount paid to the Authority. The SAIC could elect to pay the full amount even though all farmers had not paid, in order to ensure a full SA supply, and collect farmer overdues at a later date.

4.06 SAIC Chairmen from all SA's within a district will form the Sub-division Irrigation Committee (SIC). This would represent the farmers in meetings with the sub-division for resolving annual operations, policies, procedures and other issues. There will be a similar committee at the division level. These will be particularly important functions in the early years. Figure 4 shows line of communication between different levels of farmer committees and O&M organizational units.

Section

4.07 A section will comprise a group of about 10 to 20 SAs and will therefore contain approximately 5,000 ha. On the average, each section will have 8 km of minors, 4 km of distributary, 6-10 cross regulators, 10-20 offtakes to SAs and 10 km of natural and improved drains. To carry out maintenance, each section will be staffed by one maintenance foreman and three laborers/light equipment operators who preferably will reside within the section area. These staff will report to the Sub-divisional Officer - Maintenance and Construction. The section work station will have a small office and store room, a fenced yard and storage shed(s) for supplies, vehicles and

^{1/} It should be noted that the Authority has ultimate responsibility for channel maintenance down to the sub-chak level. To the extent possible, day-to-day maintenance within the SA will be carried out by farmers, with Authority assistance as appropriate. A monetary incentive such as reducing service assessments to farmers should be used in recognition of lowered direct project maintenance costs due to the efforts of the SA members.

equipment. Living quarters might well be part of the work station, which should be located centrally with respect to the canal and drain system. Security will be improved by this arrangement.

Sub-division - Irrigation

4.08 The sub-division, headed by a Sub-divisional Officer, will be the lowest administrative unit in the project and is the entity which directly serves the SAs. As indicated in figure 3, the sub-division will service approximately 50 to 100 SAs grouped into five sections of 10 to 20 SAs each. Hence, the sub-divisions will normally have a size of approximately 25,000 ha, with 50 to 100 SA turnouts and about 100 km of canal and drainage channels.

4.09 A canal operator will be responsible for operating approximately 30 km of canal (the area covered by about two and one-half sections) serving about 25 to 50 SAs. If he has more than 35 SAs and they are spread out, an assistant may be needed. In addition to his normal water operation duties, the canal operator will spend some time each day working with SAIC Chairmen to review operations within the SAs and to facilitate liaison between the Sub-divisional Officer Operations and the SA and individual farmers. It will be noted that each sub-division will require, on the average, only three canal operators, and that this is generally sufficient to ensure coverage of all operations even in the event of absence of one member. The substantial distances and areas served by each operator is a reflection of the relative ease of operation of the system as adopted in the project criteria. (It may be desirable to sell motorbikes at low prices to the operators and then pay a monthly sum for his use of it on project work in order to incur minimum costs while accommodating his desire for personal use of the bike). Canal operators will assist the agricultural extension advisor on technical matters pertaining to the system in the determination of SA irrigation schedules.

4.10 Supervision and training of operators will be by the Sub-divisional Officer-Operations (SOO). In addition, the SOO will spend about half of his time in the field with SA representatives to assist in solving problems, assure equitable water service to all farmers, and review the O&M of SA channels to ensure that they conform with project standards. One of his major duties, in addition to operation of the system, will be to facilitate prompt and full two-way communications of information, particularly complaints and suggestions for improvements from the farmers and between their representatives and the O&M units.

4.11 Some major maintenance equipment will be located at the sub-division office, under the direction of the Sub-division Officer - Maintenance and Construction. Depending on the extent of differences in equipment and other maintenance requirements between major canals and large drains and the smaller distributaries, it may be appropriate to include a "major channel" maintenance staff and equipment group in those sub-divisions having responsibility for such facilities.

Division, Dam and Irrigation

4.12 The unit of the project above the sub-division is the dam and irrigation division. The division will include six irrigation sub-divisions, the Dam and Power Plant sub-division, and the Main Canal and Pumping Plant sub-division. About 500 SA turnouts will be served within the division. The division will be substantially larger in regard to the area served and in its responsibilities than most existing irrigation projects today. Hence all day-to-day operational and maintenance decisions on the NSC will be centered within the division and its units. The division will be headed by a Division Manager with three Assistant Managers for Administration, Personnel and Training; Operations; and Maintenance and Construction, supported by two special units.

4.13 The division will secure and disburse its funds subject to budget review and approval by the project office. The approval from the Project Manager will be required for all overages or non-budgetary item expenditures.

4.14 An important unit of the division will be an Evaluation, Planning and Budget Unit (EPBU) to be headed by a senior person with at least 15 years experience in operations and maintenance, 5 years of which should be in project administration and management. The unit Head will be assisted by three persons with broad and objective backgrounds in water project management. The principal function of the EPBU will be review, evaluate, plan and then budget the next year's activities after consultation with farmer and sub-division representatives. This unit will report directly to the Division Manager with copies of all reports and recommendations being forwarded directly to the Project Office EPBU (para 4.20).

Main Canal and Pumping Plants Sub-division

4.15 A separate sub-division will be established to operate and maintain the main canal from the head regulator to the tail including all in-line pumping plants. The organization, staffing and equipment of the main canal sub-divisions will differ from that followed in the other sub-divisions. Daily, weekly and monthly operation will be conducted under criteria and policies of the project office. Water releases to the distributary system will be in accordance with schedules received directly from the Irrigation sub-divisions operating those portions of the system. These, of course, will be in conformance with the annual allotments and schedules set by the project office.

Dams and Power Plant Sub-division

4.16 The Dams and Power Plant Sub-division will have responsibility for operation and maintenance of the Narmada Sagar dam and the civil works portion of the power plant. A sub-division officer with appropriate assistants will direct the activities of the unit. Operations of the dam will be carried out under criteria and policies of the project office. Operation of the mechanical/electrical components of the power facilities will be under another unit; the Power Division - Narmada Sagar Complex.

Division - NSC Power

4.17 The Power Division--Narmada Sagar Complex--will report to the project O&M office. It will be responsible through three sub-divisions for the O&M of the mechanical-electrical facilities to generate power at Narmada Sagar, Omkareshwar and Maheshwar power plant. Following resolution of project water operations it will, at the appropriate levels, work with the SEB and regional dispatch center to schedule power operations. The determination of basic policies and primary schedules will be the responsibility of the project office and NVD O&M.

4.18 Authority and responsibilities for day-to-day decisions, including budgeting and expenditures, will be comparable to those delegated to the dam and irrigation divisions. A close working relationship with the other divisions will be maintained to facilitate operations and to carry out maintenance in a cost effective manner.

Project O&M Office

4.19 The function of the NSC Project Office will be to assure coordination of activities of the dam and irrigation divisions and the power division and integration of project policies and activities to best meet the objectives of the State of Madhya Pradesh. Although other titles may be used, the title of Project Engineer will be used in this report for the chief executive officer of the project.

4.20 Relationships with neighboring state governments as well as policy questions will be dealt with by the MP Narmada Valley O&M Organization (NVOMO) headquartered in Bhopal. Policy and coordination action involving the NSC will be handled at the Project Office level. Annual and seasonal projections of project water availability, water allocations, power and water supply operations will be determined by the project office in conjunction with NVOMO.

4.21 With the exception of major project-wide policy decision making and the establishment of project water and power operations, no line functions will be carried out by the project office. Nor will there be any requirement for providing staff support to the units below except in unusual circumstances. In such cases, special assistance from the state or national irrigation entities or from consultants will be more effective and less expensive than the retention of full-time, highly paid staff.

4.22 The Project Engineer will meet at least monthly with the Division Managers and semi-annually with Sub-division Officers. The Head of the Evaluation, Planning and Budget unit at project level meetings with Division Managers on a quarterly basis to ensure optimum performance of project responsibilities at all levels.

Narmada Valley O&M Office - Chief Operations and Maintenance

4.23 The Narmada Valley O&M Office (NVOMO) will be responsible for coordinating all projects within the MP portion of the Narmada River Basin. It will receive and analyze necessary data and issue instructions to the individual projects as relating to water allocations, weekly reservoir release under normal operations, and hourly releases under emergency operations. It will set guidelines; inspect procedures and facilities; and assess results of all basin projects.

4.22 The NVOMO will represent MP in exchange of information and coordinate operations with other basin states and will provide the state's representative on the NCA.

E. STAFFING, FACILITY AND EQUIPMENT REQUIREMENTS

5.01 Staffing, facilities and equipment needs are described for each unit in the organization. These are listed for each entity, office or location and are not aggregated to higher levels.

5.02 The requirements listed are for "typical" organizational units for use in O&M planning. Final requirements will differ as they reflect actual situations and conditions. For example, the size and number of open drains and size of canals will vary considerably from one area to another. These, particularly the drains and large canals, will greatly affect equipment and associated personnel needs. It should be noted that some equipment at the sub-division and division level serves as back-up to lower units and can be pooled to meet peak demands. In emergencies, mutual support by units will be possible.

5.03 Certain facilities, communication systems and equipment to be used during construction will be transferred to the O&M units. Because the O&M use is long-term, compared to the construction period, anticipated O&M functions and requirements should have priority in design and specifications for procurement of such items with construction elements accommodated on a temporary basis. To the extent possible, buildings and facilities for construction should be located to best suit O&M requirements.

5.04 The typical sequence of promotion/advancement and qualification needed for management staff at sub-division and divisional level to higher posts in any unit, will be modified from the normal procedure in GOMP. Adequate levels of compensation, equivalent to those of other utilities are a must. Permanence and continuity are required. These features are essential in order to retain experience and working relations in the units. This was discussed in para 1.04 as well.

Staffing, Facilities and Equipment

5.05 The basic staffing, facilities and equipment is presented for each designated unit. It should be noted that the level of individual in each position is not indicated. These are to be set following further examination of policies to be adopted for the Authority's utility organization.

Section

(a) Staffing:

- (i) 1 Maintenance foreman/sectional officer (non-engineer)
 - 3 laborers/small equipment operator
 - casual labour will be hired for peak work needs only as required

(b) Facilities:

- storeroom and small office with desk and file for canal
- operator and foreman
- living quarters for foreman
- storage shed(s)
- fenced compound
- fuel storage

(c) Equipment:

- 2 30-40 HP 'farm' tractors (diesel) with 3 pt. hitch and attachments
- 1 50-70 HP tractor with backhoe and front end loader (FEL) (diesel)
- 1 3/4 ton pick up with dump bed (gas or diesel)
- 3 3-wheel cycle with box/storage/bed at rear

5.06 Sub-division - Irrigation

(a) Staffing:

(i) Sub-division Officer

- 1 clerk/secretary, finance
- 2 collection clerks
- 1 assistant clerk - payroll records, bookkeeping, water and organization records, storekeeper
- 1 secretary/typist

(ii) Assistant Sub-division Officer - Operations

- 4 canal operators

(iii) Assistant Sub-division Officer - Maintenance and Construction

- 2 equipment mechanics
- 1 maintenance man - electrician
- 1 vehicle dispatcher/storekeeper

(Maintenance persons for some of the sections may best be located at the sub-division office).

(b) Facilities:

- building with reception area, 4 offices and 2 conference rooms capacities for 50 people and 20 people
- storage building - warehouse
- storage sheds
- fuel storage/equipment service shop
- fenced compound
- living quarters as appropriate - two people minimum

(c) Equipment:

- 2 dump trucks - 1 large, 1 small
- 1 75-100 HP diesel "farm" tractor with backhoe (6 m reach) and front-end loader
- 1-15 T low-bed trailer (two-type, not 5th wheel)
- 1 full grader
- 1-3/4 ton pick up with utility bed and hoist (for pump work)
- 1-1 sock concrete mixer
- 3-1/2 ton pick ups
- 1 - 4x4 vehicle (jeep)
- 8-3 wheel motorcycle with box bed (depends on total number of canal operators)
- air compressor (100 cfm)
- 1 small generator, 2 small pumps
- 1 air compressor (100 cfm)
- 1 microprocessor

5.07 Division - Irrigation, Main Canal and Dams and Plants

(a) Staffing:

(i) Division Manager

- 1 receptionist
- 1 secretary
- 2 computer operator/word processors
- 1 clerk typist

(ii) Head, Evaluation, Planning and Budget Unit

- 3 senior assistants

(iii) Assistant Division Manager - Administration, Divisional Accounting, Finance

- 1+2 audit and cost accounting
- 1+3 water assessments
- 1+2 payroll
- 1+4 collection and financing
- 1+2 purchasing - stock control

- 1+2 computer service, programming
 - 1+1 communications clerk
- (iv) Assistant Division Manager - Personnel and Training
- 1+1 personnel
 - 1 training
 - 3 clerk typists
- (v) Assistant Division Manager - Operations
- 2 hydrologists/water routing
 - 1 civil drainage engineer or technician
 - 3 crop and water records clerks (1 senior, 2 juniors)
 - 2 clerk typists
 - 2 computer operators
- (vi) Assistant Division Manager - Maintenance & Construction
- 1 secretary
 - 1 clerk typist
 - Chief equipment maintenance section
 - 2 clerk typists
 - 1 foreman, shop - heavy equipment, 2 mechanics
 - 1 foreman, shop - light equipment, 2 mechanics
 - 1 foreman, shop overhaul and repairs
 - 1 machinist - mechanic, electrician
 - 1 vehicle dispatcher/storekeeper
 - Maintenance foreman
 - 5 maintenance men
 - 10 labors (primary)
 - 4 heavy equipment operators
 - 6 helpers
 - Chief - construction section
 - 2 construction crews of 17 persons each (foreman, 3 general construction, 2 steel and 4 concrete workers, and 7 laborers)
 - 2 junior engineers/draftsmen
 - 2 clerk typists
 - sub-engineer (electric)
 - Chief - communications/electronics repair (electrical or electronics engineer)
 - 3 computer/radio technicians

(b) Facilities:

Size of buildings and shops required will be dictated by number of staff. A conference-meeting room for each department should be provided. A large meeting room, equipped with audio/visual facilities with seating for about 200 people should also be included. Repair shops, electronics shop, spare parts, supplies storage and mess facilities are a few of the additional special needs to be provided in the complex.

(c) Equipment:

(i) Heavy equipment

- 2 excavators (hyd. ditch cleaning) (D.9 m3) (if major canals or channels within division, add 1 with 1.4 m³ capacity, and long-reach capability)
- 1 tractor, crawler - 150 HP with dozer, ripper
- 2 tractor, crawler - 100 HP with dozers, ripper
- 1 scraper, 10 m³
- 2 loaders rubber tired - 2 m³
- 1 roller, rubber tired (vibrating)
- 1 roller, sheeps foot
- 2 motorgraders (cat 12 or equal)
- 1 trailer, towbed - 30 T
- 1 trailer, towbed - 40 T
- 1 truck, with 5th wheel to match trailers
- 1 forklift - rubber tired - ground use 8,000 lb, cap. 14' ht.
- 1 forklift - rubber tired - ground use 4,000 lb, cap. 16' ht.
- 1 truck crane - rubber tired - hydraulic 10 T, 60' boom

(ii) Light equipment:

- 5 1/2 ton pick up
- 3 3/4 ton 4x4 pick up
- 4 dump trucks
- 3 automobiles
- 4 pumps - low head - 5-150 HP
- 2 compressors 200 cfm, 360 cfm
- 4 generators, portable, 2.5 kW - 12.5 kW
- 3 concrete mixers, 1 sack

5.08 Sub-division - Main Canal and Pumping Plants

(a) Staffing:

(i) Sub-division Officer

- 1 assistant clerk - payroll records, bookkeeping, storekeepers
- 1 secretary-typist

(ii) Assistant Sub-division Officer - Operation

- 2 scheduling specialists
- 4 canal operators (engineers)

(iii) Assistant Sub-division Officer - Maintenance and Construction

- 3 maintenance foreman
- 9 laborers/small equipment operators
- 2 mechanics
- 1 maintenance man - electrician
- 1 vehicle dispatcher/storekeeper

(b) Facilities:

- building with reception area, 4 offices and one conference room with capacity for 20 people
- storage buildings - warehouse
- storage sheds
- fuel storage/equipment service shop
- fenced compounds
- Living quarters as appropriate - two people minimum

(c) Equipment:

- 2 dump trucks - 1 large, 1 small
- 2 75-100 HP diesel "farm" tractor with backhoe (6 m reach) and front end loader
- 3 30-40 HP "farm" tractors (diesel) with 3 pt hitch and attachment
- 1 15 T low-bed trailer (tow-type, not 5th wheel)
- 2 motor graders
- 1 - 3/4 ton pick up with utility bed and hoist
- 2 - 1-sack concrete mixer
- 6 - 1/2 T pick ups
- microprocessor(s)
- 1 air compressor (100 cfm)
- 1 small generator,
- 2 small pumps

5.09 Project O&M Officer

(a) Staffing:

- (i) Project Engineer
 - 2 secretaries/receptionist
 - 1 clerk/typist
 - 1 computer operator/word processor
- (ii) Assistant Administrator - Administration
 - secretary
 - 4 computer operators/word processors
 - 5 reports and publications (clerk/typists, writers, artists, draftsmen)
- (iii) Assistant Administrator - Training
 - training institute
 - faculty
 - staff
 - 3 personnel
- (iv) Assistant Administrator - Operation and Maintenance:
 - water supply forecasting
 - 1 water operations
 - 1 power operations
 - 1 project maintenance and dam safety

(b) Facilities:

Office space for staff and support equipment and supplies.
Conference room for 20 people is adequate.

(c) Equipment:

- office equipment
- automobiles

5.10 Sub-division - Dams and Plant

The various functions of the subdivision are operation and maintenance of civil works of dam and powerhouse; instrumentation; management of the reservoir; sedimentation observations; maintenance of gauge and discharge station; collection of other data; and maintenance of colonies and roads of right and left bank at Narmada Sagar colonies, Khandwa and Bir.

(a) Staffing

- (i) Sub-division Officer
 - 1 Assistant Clerk Payroll records, bookkeeping, storekeeper
 - 1 Secretary/Typist
- (ii) Assistant Sub-division Officer - Operations
 - 2 dams operations
- (iii) Assistant Sub-division Officer - Maintenance
 - 1 dam and waterways maintenance foreman
 - 1 power plant/switchyard maintenance foreman
 - 6 laborers/small equipment operator
 - 2 mechanics
 - 1 maintenance man-electrical
 - 1 vehicle dispatcher/storekeeper

(b) Facilities

(same as main canal)

(c) Equipment

- 1 dump truck - large
- 1 75-100 HP diesel "farm" tractor with backhoe (6 m reach)
- 1 30-40 HP diesel "farm" tractor with 3 pt hitch and attachments
- 1 motorgrader
- 1 3/4 ton pick-up with utility bed-hoist
- 1 - 1 sack concrete mixer
- 4-1/2 ton pick up trucks
- small generator
- small pump
- air compressor

5.11 Power Division

(to be completed)

F. SHOP EQUIPMENT, HAND TOOLS, SPARE PARTS AND SUPPLIES

6.01 Equipment and tools for repair shops, hand tools for field staff, spare parts for equipment and an inventory of supplies, i.e. tires, lubricants, cables, engine parts, etc. have not been listed. These quantities are to be developed.

Building

6.02 Buildings will be designed to utilize standard plans throughout the project with modifications where unit requirements differ from the norm.

G. COMMUNICATIONS AND COMPUTER EQUIPMENT

Communications Equipment

7.01 Communications equipment has not been specifically designated. However, a very reliable modern system is essential. The system must provide for transmitting information among offices including the farmer entities and representatives involved, and among field vehicles and offices. It must also provide for monitoring of the physical facilities and conditions in the project. The system must permit remote operation of facilities as provided in the design.

Computer Equipment

7.02 Computer equipment of two levels of capability will be needed. Small computers will be adequate for office accounting, inventory control, and many computational problems. At the division level, greater capability will be needed for scheduling and analysis of hourly, daily and weekly system operations. Capability to interface with remote monitoring and control equipment will be necessary. Established programs to assure system response and direct each facility's operations under various types of emergencies must be in place and ready for activation when needed. Storage, retrieval and manipulation of data on water deliveries, cropping patterns, climate and other factors must be possible at the division level with appropriate visual displays for operation and print out for use in reports. Much of the data will be logged and available for display or maps. An early analysis by people experienced in the type of canal operation selected for this project - both physical and accounting - aided by people knowledgeable in computers and communications will be needed to formulate the combination of equipment to best meet the overall requirements. Alternative means of specifying procurement, installation and development of software must be considered in the course of this effort. Computer equipment, and most programs, will be identical in all parallel offices. Some functions at the various offices are listed to permit focussing on this subject. But all should be examined further.

7.03 Divisional centers will be responsible for water operations and maintenance of facilities of all subsystems within their jurisdictions. The computer functions to be performed at the divisional center include:

Data Storage

- (a) Information identifying every structure, reach of canal, water supply, and service areas in the area.
- (b) Historical and current annual and seasonal surface water deliveries, total volume and weekly peak discharge through each reach of canal and to each service area.
- (c) Historical data on water supply to each SA derived from farmer wells and from river supply.

- (d) Precipitation: location, amount and data.
- (e) Storm patterns - frequency, extent and direction of travel.
- (f) Historical and current cropping and harvest in each SA.
- (g) Current annual and seasonal water allocations to each SA.
- (h) Seasonal projection of source of water to be supplied to each SA.
- (i) Current irrigation size and schedule requested by SA and amount delivered to date.
- (j) Schedule of discharge by date through the season through each reach and structure.
- (k) Projected pumping plant/power plant operation and cross-regulator gate positions and operations for next period (8-12 hours).

Display screens of system on large visual:

- (a) Operational status of all facilities
- (b) Discharge through all structures.

Digital display of the specifics of all features at each flow control structures:

- (a) Display on large map for projection on screen (Item (a) through (m)).
- (b) Digital display by site or subarea (Item (b) through (m)).

Visual display in tabular form:

- (a) Maintenance/outages of facilities.
- (b) Maintenance schedule and activity at each structure.
- (c) Maintenance schedule and activity on equipment.
- (d) Assignment of personnel.
- (e) Status and assignment of vehicles.
- (f) Status and assignment of equipment.
- (g) Construction activities.

Operational programs for:

- (a) Defining gate positions and plant operation for each state flow condition.
- (b) Describing conditions at each structure and other selected sites under conditions of any selected flow change and gate and plant operation.
- (c) Describing desired settings and operational sequence of structures to comply with criteria for any selected change in flow - discharge and time period.
- (d) Describing operations of facilities under any of a number of predefined emergencies.

Additional information on these needs is presented in the document, Project Criteria and Plan of Operation (Schedule A).

7.04 The project office will require capability to store and manipulate information gained from the divisional offices concerning cropping and water deliveries and system operations. Additionally, information on river flows, basin climate and power and reservoir releases will be secured, stored and used in analysis. The primary computer programs (and capability) at the project office will be sufficient to monitor and predict hourly, daily, monthly, seasonally and annual basin water conditions. This will be used to determine operations for purpose of water allocations and deliveries, power operations, and flood regulation. As elsewhere, small computers can be used for other office functions. The higher capacity computer used by the Authority for design analysis at Bhopal should be used for analysis of canal transients and complex system operations. At the onset (1986) the O&M staff should have full access to that equipment for their needs and no separate equipment should be purchased.

7.05 At some time in the future the linkage of the divisional centers can be installed and the larger computer capacity secured and located as appropriate for operating the major project areas then delineated. But no special attention is required now since this is many years in the future.

7.06 One other function which will be provided in conjunction with the training center will be the real time simulator for training of operators. This, however, should be carried out utilizing the computer equipment secured for other purposes.

H. STAFF DEVELOPMENT

8.01 The initial O&M cadre assigned to the project must be experienced and well-qualified administrators, generalists, engineers and technicians, all of whom will be expected to remain with the project for a period of many years. The Narmada Sargar Complex O&M staff will be permanent and functionally

autonomous as described. There should be no transfers in or out of the O&M unit except for just cause or to meet emergencies in other locations. Minimum periods with the units should be five years under any but the most unusual cases. It must be viewed as a career.

8.02 In order to foster staff perseverance, special emphasis on recruiting local people should be made. Also, and very importantly, many of the positions need not be filled by graduate engineers. Management ability, knowledge of irrigation and O&M and attitude are the most important characteristics. And in every instance the individuals must be satisfied in staying with the O&M Agency and in the specific project area. This will be an essential requirement of all staff at every level.

8.03 Superior performance at all levels will be recognized and rewarded promptly by internal action. Such actions, together with similarly appropriate action in the case of unsatisfactory performance, will be within the authority and responsibility of unit offices down to the sub-division level. Seniority should carry only limited importance in consideration for advancement. Promotions will be from within the organization whenever possible. Recognition of solid performance, the possibility of promotion, and adequate pay levels will serve as three of the strongest inducements for overall staff accomplishment and staff permanence, so necessary for making the project successful. Figure 5 illustrates example paths for O&M staff promotion.

8.04 A small permanent training center including necessary buildings and facilities for training O&M staff and farmer representatives of the SAs will be established in Phase I area of the project. This will be an ongoing institution. (Prior to its establishment training will be provided in Bhopal and elsewhere as appropriate. However, this initial training will also be directed by an O&M staff member and the courses provided by experienced O&M and specialist personnel). The primary functions of the O&M training center will be:

- (a) Staff orientation and training for initial O&M assignment;
- (b) Instruction in water operations in project facilities with courses which will concentrate on system operation theory and practice, techniques of maintenance and construction, administrative and fiscal matters, farmer relations, and personnel management;
- (c) Background training in on-farm water management, crop-water requirements, full and supplemental irrigation of crops, and similar agricultural factors useful for O&M personnel. Although this training could be furnished separately to O&M staff and farmer representatives, there would probably be significant benefit to having both groups participate in the same classes; and
- (d) Providing courses to upgrade special technical and managerial skills.

The training center will be established and staffed at the very early stages of project development so that the requisite specialized courses focusing on

the particular characteristics of this project--the facilities and their operation--can be provided to the O&M staff who will initiate water deliveries to the project lands. The facility need only be adequate for the training of staff for one or possibly two sub-divisions at one time, because cadre for additional increments of the project, as completed, will be drawn in part from the then existing O&M staff. This training activity, however, will remain relatively constant over a long period of time as the project expands.

8.05 During the initial stages of project development, there will not be a need for staffing or facilities above the division level except a limited project office staff to evaluate water supply conditions, coordinate water allocations, schedule water and power operations at the reservoir and prepare basic policies and guidelines.

8.06 Further treatment of staff training and other institutional matters is presented in annex 2.

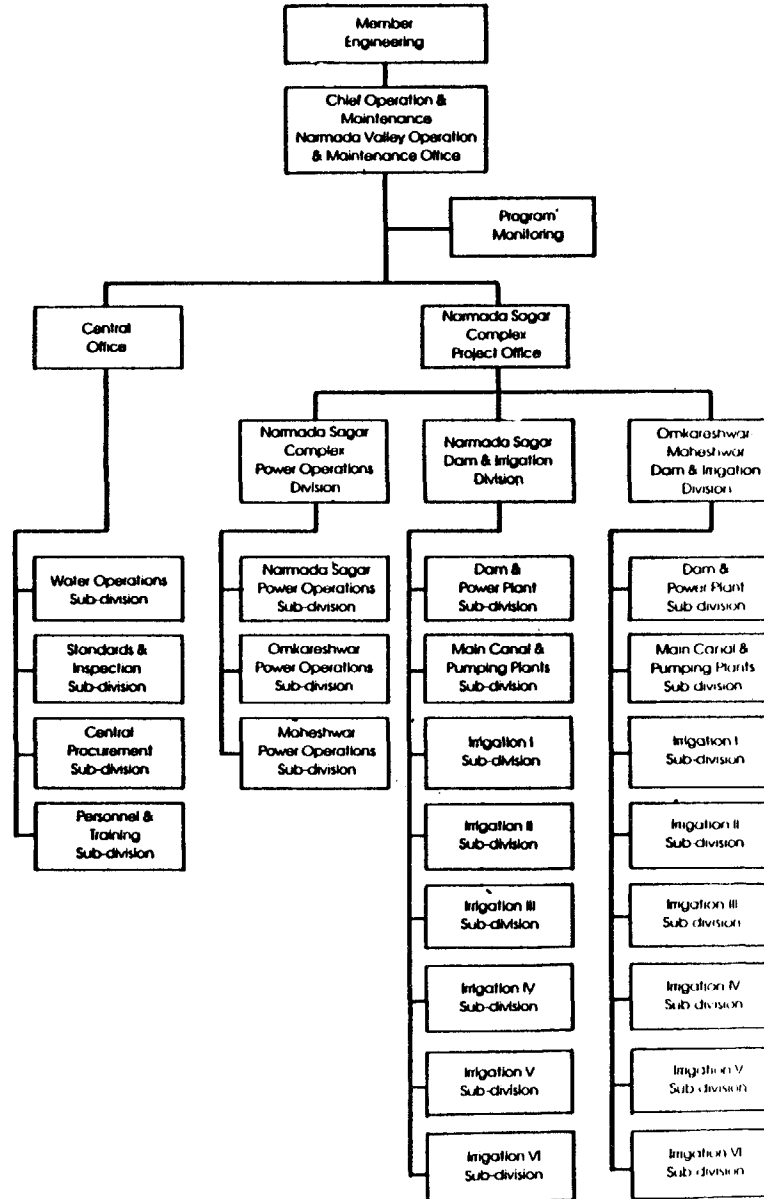
I. MANUALS AND PROCEDURES

9.01 Manuals presenting procedures and standard operation and maintenance methods, policy manuals, and administrative and management instructions, will be prepared in advance of commencement of O&M field activities on the project. These will be modified as experience in the first portions of the project is gained. The initial full set of documents, however, must be completed several months prior to turning water into the main canal and three months prior to staff training to allow preparation of training lessons and materials.

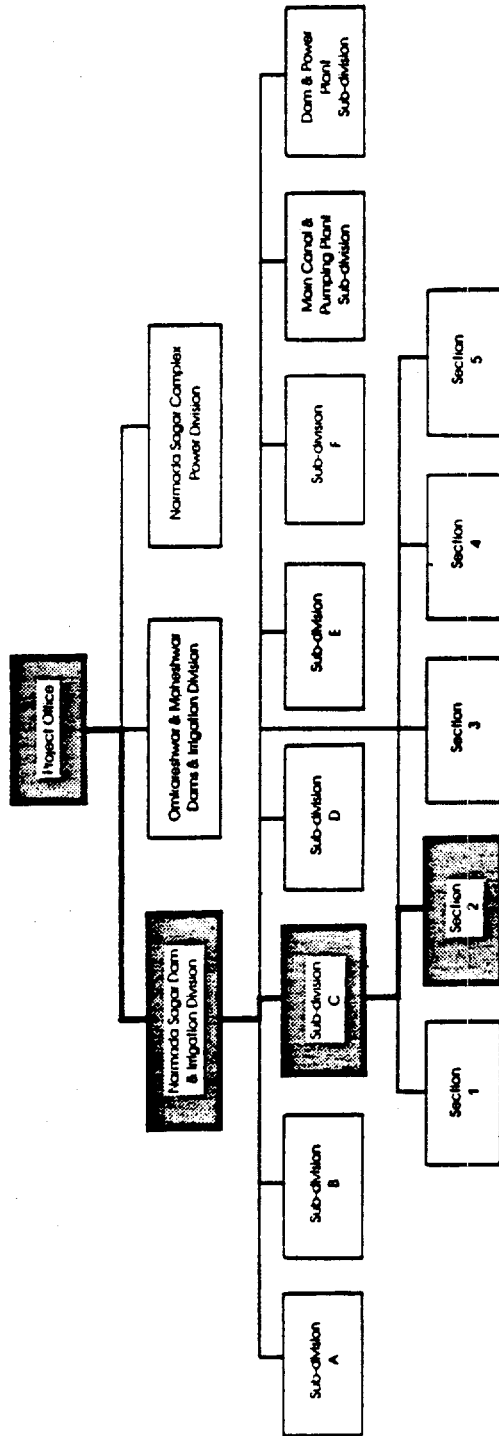
J. COST ESTIMATES

10.01 Estimates of 1985 base recurring and non-recurring costs have been developed. These estimates reflect the staff, facilities and equipment presented herein. Results are shown in tables 1,2 and 3. A contingency of 15% is provided for in the totals of the non-recurring.

INDIA
 Madhya Pradesh
 Narmada Valley Development Authority
 (Organization for Operation and Maintenance)

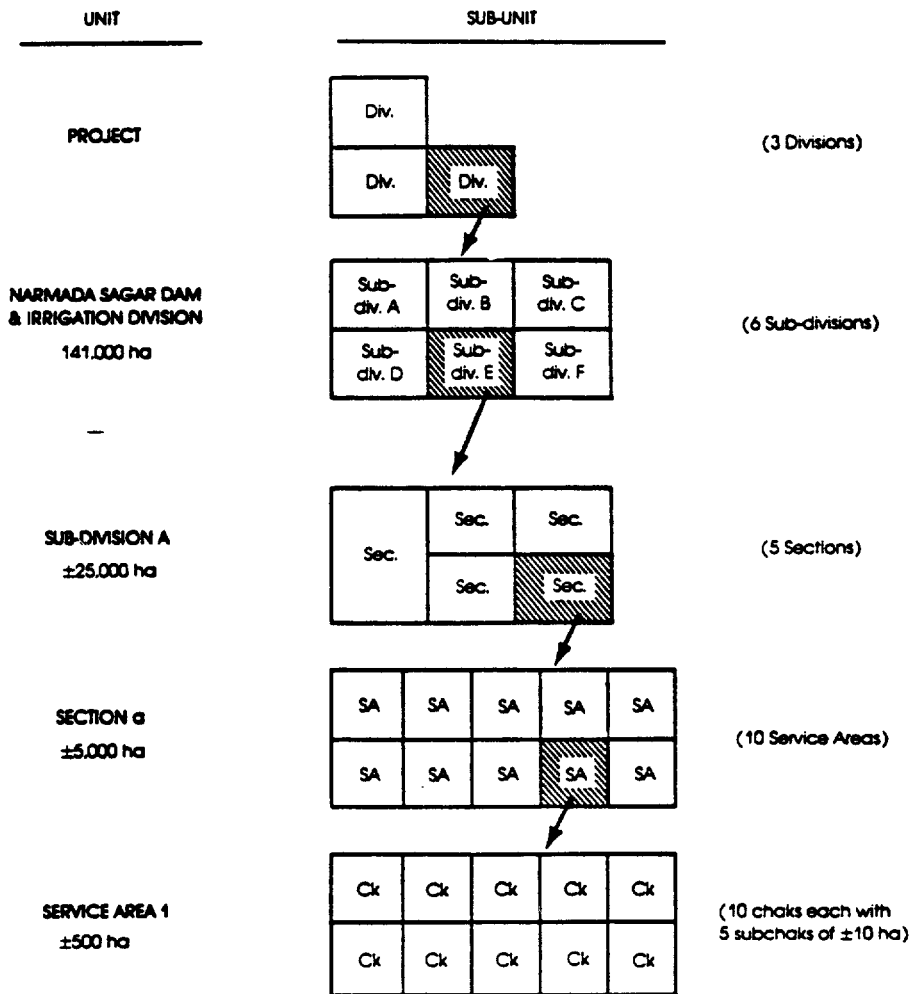


INDIA
Madhya Pradesh
Narmada Valley Development Authority
(Operation and Maintenance Organization)

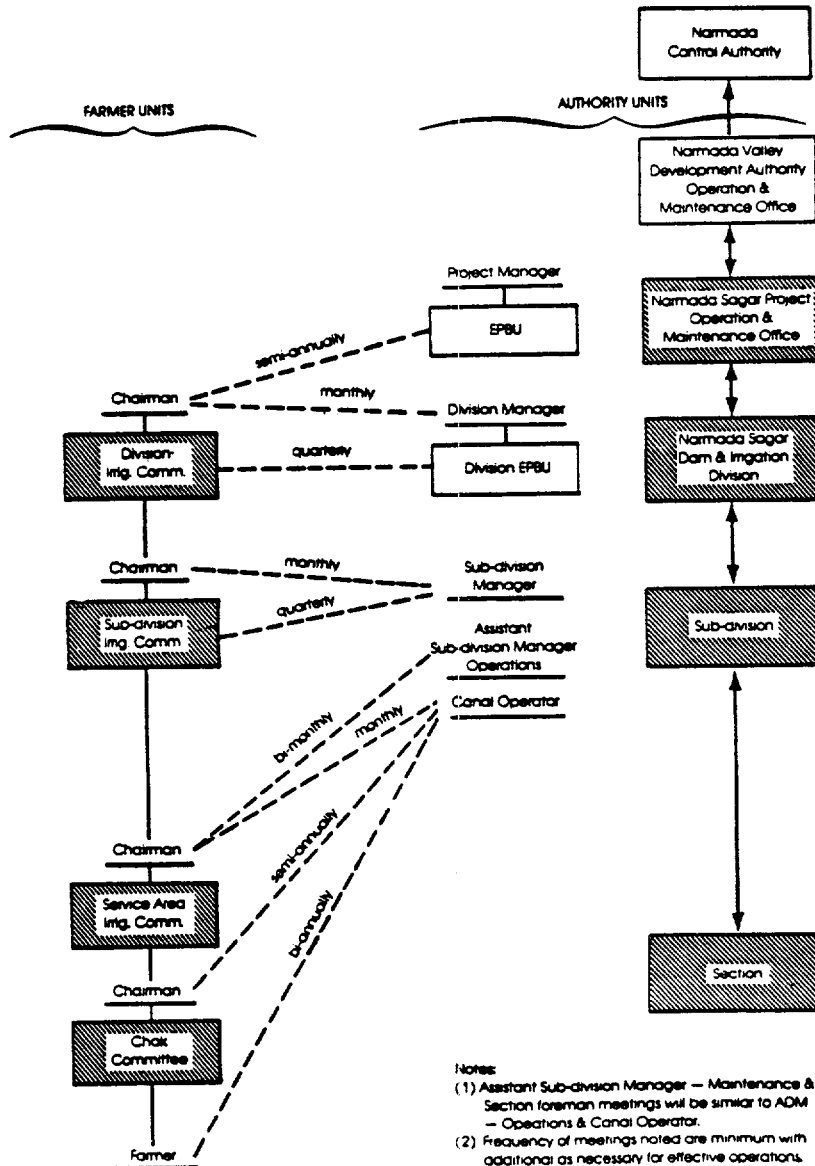


Notes:
(1) Only one line of reporting shown to exemplify organizational structure
(2) Sub-divisions A through F are Irrigation Sub-divisions.

INDIA
Madhya Pradesh
Narmada Valley Development Authority
Composition of Each Unit and Area Under Its
Jurisdiction for the Irrigation Service

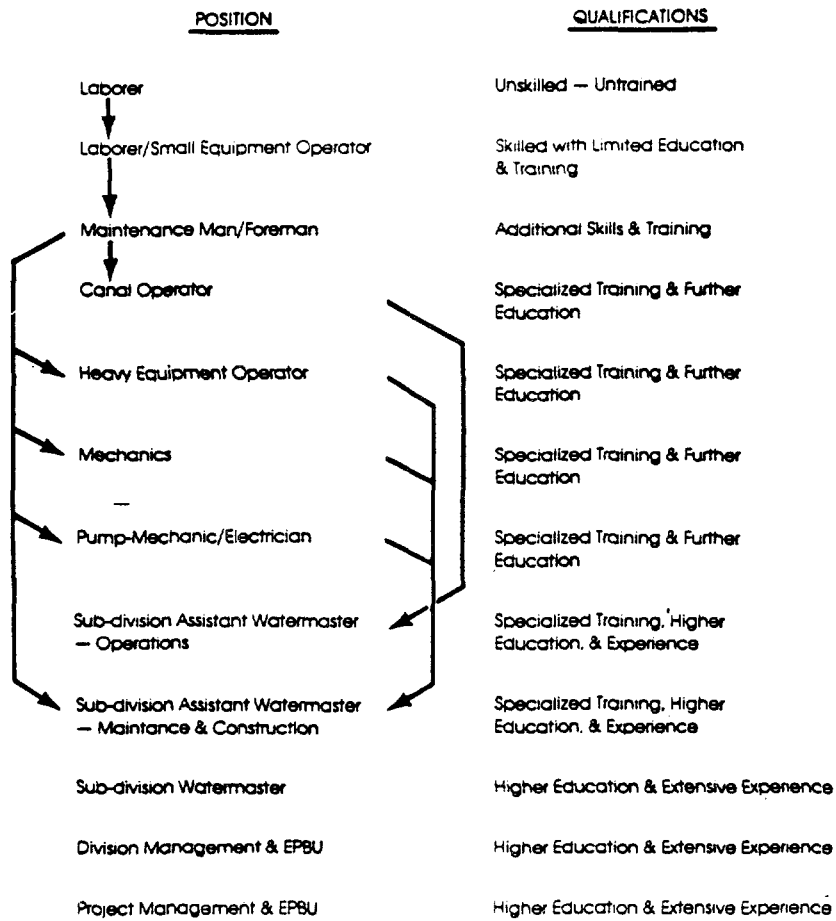


INDIA
Madhya Pradesh
Narmada Valley Development Authority
Lines of Communications
Farmer and Authority Units



- Notes:
- (1) Assistant Sub-division Manager — Maintenance & Section foreman meetings will be similar to ADM — Operations & Canal Operator.
 - (2) Frequency of meetings noted are minimum with additional as necessary for effective operations.

INDIA
Madhya Pradesh
Narmada Valley Development Authority
Example Position Qualifications and
Typical Sequence of Advancement

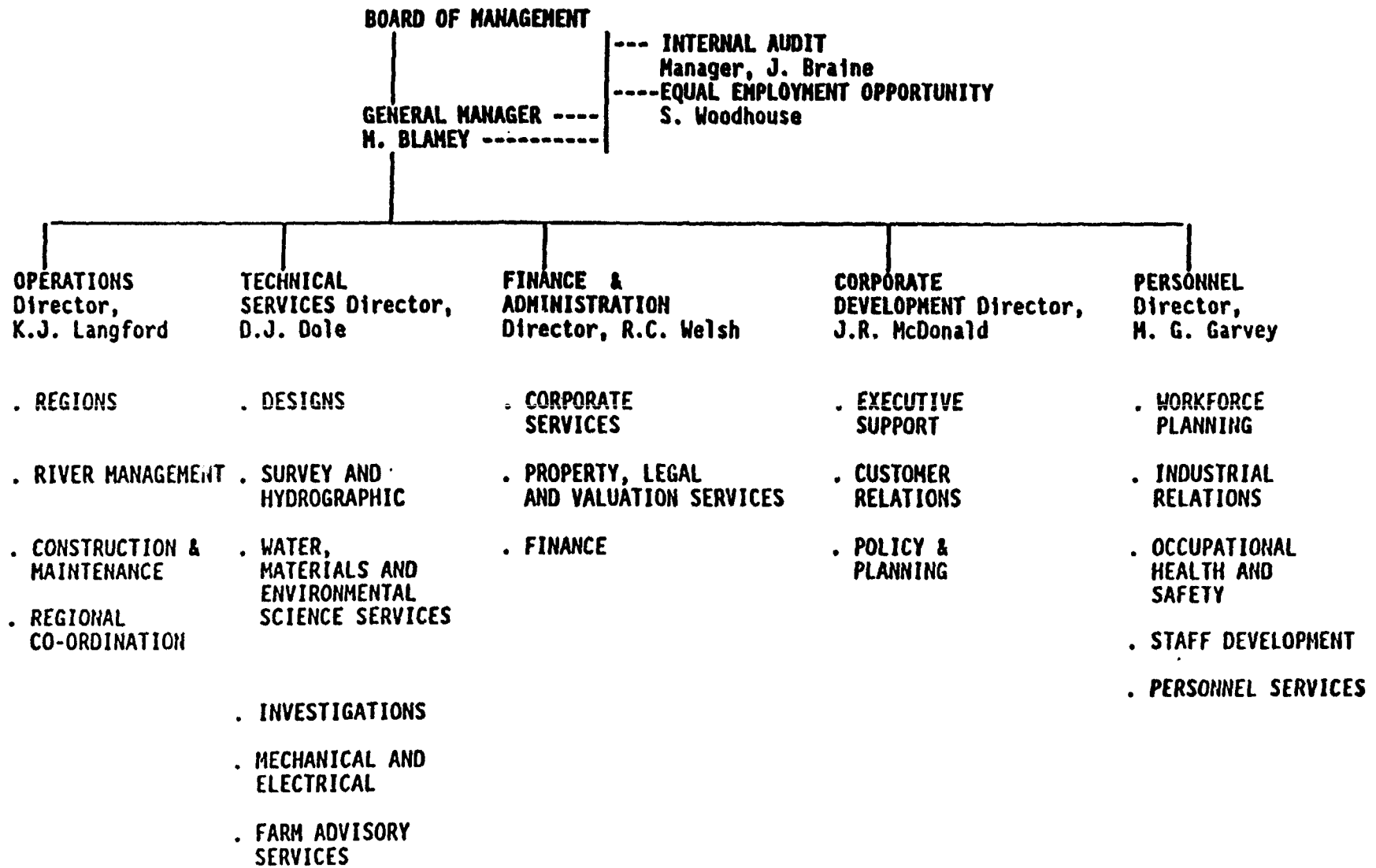


Note: Management staff at sub-division & divisional level may advance to higher appropriate positions in any unit

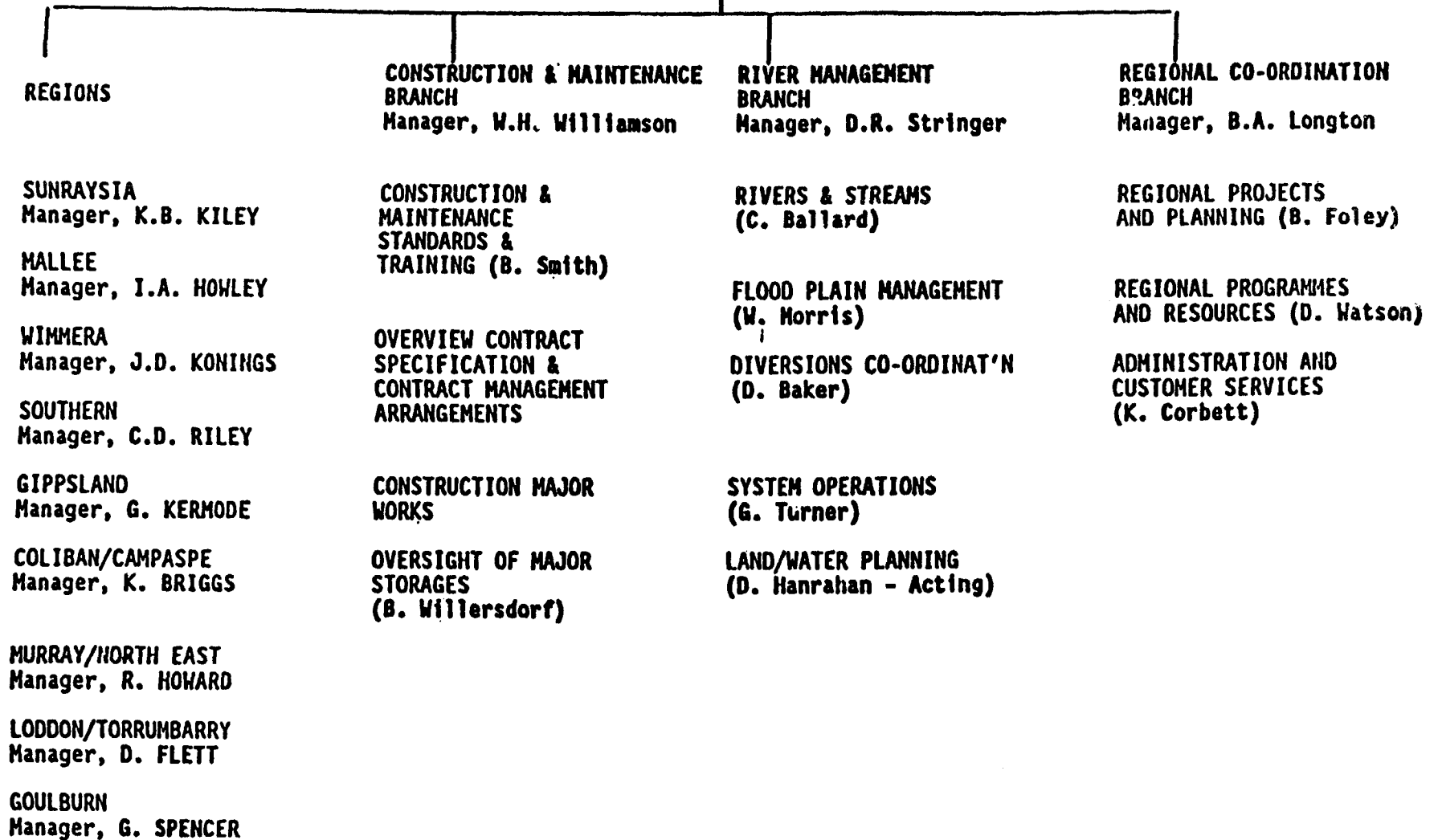
ANNEX 2.3

RURAL WATER COMMISSION, AUSTRALIA

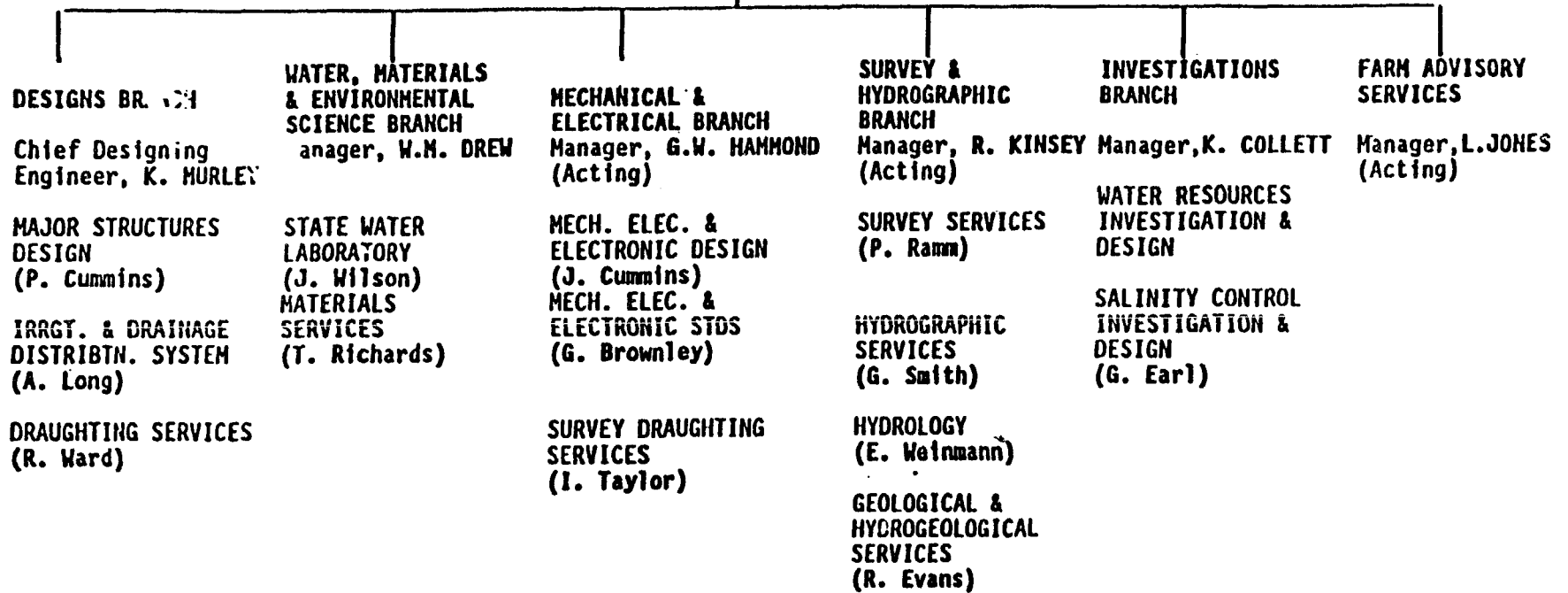
ORGANISATION STRUCTURES AS AT DECEMBER 1987



**OPERATIONS DIVISION
DIRECTOR, K.J. LANGFORD**



**TECHNICAL SERVICES DIVISION
DIRECTOR, D.J. DOLE**



**CORPORATE DEVELOPMENT DIVISION
J.R. McDONALD**

Customer Relations

S. STONE

Policy and Planning

VACANT

**Executive Support
(formerly Secretarial)
STUART GEMMILL**

**FINANCE &
ADMINISTRATION DIVISION
DIRECTOR, R.C. WELSH**

**PROPERTY, LEGAL & VALUATION
SERVICES BRANCH**

Manager, T. CHANDLER

**LEGISLATION AND LEGAL
SERVICES**

PROPERTY SERVICES

**VALUATIONS
(L. Reddan)**

**FINANCE
BRANCH**

Manager, M.W. GERAGHTY

**ACCOUNTING SERVICES
(B. Stanlake)**

**SUPPLY SERVICES
(N. Payne)**

**FINANCIAL SERVICES
(R. Jenkins)**

**TREASURY
(P. Eldridge)**

**CORPORATE SERVICES
BRANCH**

Manager, W.A. CLARKE

**ADMINISTRATIVE SERVICES
(D. Beaumont)**

**SYSTEMS AND E.D.P.
(P. Tillig)**

**INFORMATION SERVICES
(S. Stevens)**

**LIBRARY
(V. Nicholson)**

**RECORDS
(G. Wiggins)**

**PERSONNEL DIVISION
DIRECTOR, M.G. GARVEY**

**Organisation
Classification and
Workforce Planning
VACANT**

**Personnel Services and
Recruitment
I. Singleton**

**Personnel
Development
P. Saunders**

**Industrial Relations
and Occupational
Health & Safety
R. J. Watson**

OPERATIONS DIVISION

Director	John Langford	
Regional Coordination	Brian Longton	Responsible for: <ul style="list-style-type: none">- The coordination of regionalisation processes including appointments, developing structures, supervisory levels, regional office requirements and coordinating transfers of functions to regions- Heading and coordinating cross regional projects such as Channel Systems Project- Coordinating the development of new materials and development of metering devices- Coordinating industrial relations problems and negotiations- Coordinating financial and budgetary activities in regions- Developing pricing policies and the introduction of a capital charge for new water allocations- Coordinating corporate responses to Advisory Boards, Committees and Peak Councils
Water Management	David Stringer	Responsible for: <ul style="list-style-type: none">- Management of the Commission's interest in the States water resources and water-related land resources, namely:<ul style="list-style-type: none">- Flood investigation and mitigation- Control of activities on streams and rivers (including provision of technical and financial assistance)- Control of the private use of water from watercourses and groundwater- Monitor and assess available water resources to ensure the optimum operation of the irrigation and drainage systems- Manage Commission lands and provide advice on the management of private lands
	Clarke Ballard Currently Acting	
Construction	Bill Williamson	Responsible for: <ul style="list-style-type: none">- Undertaking declared major projects- Provision of project management support to Regional Managers- Support to Regional Managers for overall maintenance of storages and major structures- Setting contract policy and procedures and provision of contract administration advice and training- Setting construction and maintenance standards and provide advice and training
Coliban/Campaspe	Ken Briggs	Responsible for: <ul style="list-style-type: none">- 11 urban systems ranging from provincial cities such as Bendigo and Castlemaine to small townships like Raywood- The Coliban rural system supplying irrigation and domestic and stock water- Use of water by private diverters and from groundwater resources- Operation and maintenance of 7 major storages including Lake Eppalock- The central plant workshop and Bacteriological Laboratory

Gippsland

George Kermode

Responsible for:

- The Macalister Irrigation District together with the surface and sub-surface drainage system
- Use of water by private diverters and from groundwater resources
- Lake Glenmaggie and Cowwarr Weir
- Implementation and management of flood plain management strategies for Traralgon Creek, Sale Flood Study and Seaspray Flood Study
- Provision of advisory services and extension advice to rural water users

FUNCTIONAL STATEMENT OF EACH ORGANISATIONAL UNIT

IN TECHNICAL SERVICES DIVISION

Technical Services Division (400)

The Technical Services Division is responsible for the delivery of technical and scientific services in support of the Commission development and management and to external authorities as follows:

- (a) Irrigation and related practices;
- (b) Water, Materials and Environmental Sciences;
- (c) Survey and Hydrographic services;
- (d) Civil, Mechanical and Electrical Design and Drafting; and
- (e) Water Resources, Geology, Hydrogeology and Salinity investigations.

It is also responsible for:

- (a) coordination of the Commission's activities as Victorian constructing authority for the Murray Darling Basin Commission; and
- (b) overall direction of the Commission's overseas projects.

Irrigation Services (271)

To provide advisory services (water supply, irrigation, drainage and salinity control and research) for the Commission, consumers and the community.

Water, Materials and Environmental Science Branch (467)

To provide scientific data to assist the Commission and its major clients in managing water, water-related services and the necessary infrastructure and regulatory mechanisms for irrigation, domestic, stock, commercial, industrial, recreational and environmental uses in Victoria.

Survey Service Unit (471)

To collect, compile, present and record in an efficient and effective manner, survey data for investigation, design, construction and operation of Commission works; supporting the Commission in ongoing programs and in the development of new programs, projects and initiatives.

Hydrographic Service Unit (472)

To support the development and management of water and land resources through the provision of appropriate hydrographic services.

Designs Branch (477)

To support the Rural Water Commission's Statutory objectives through the provision of efficient and effective: design, safety surveillance, and expert advisory services.

Mechanical (480)

To provide or arrange for the provision of mechanical, electrical, electronic and cathodic protection design and maintenance services to meet the needs of the Commission and other sectors of the water industry as may request advice or assistance.

To provide a responsive and economic service in managing the Commission's holdings of mobile plant, motor vehicles and equipment to meet the needs of the Commission.

To provide a Project Engineering Service to the Regions which specifically meets the requirements of the Commission's activities.

To manage a manufacturing operation (Bendigo Workshops) that is cost competitive with private industry.

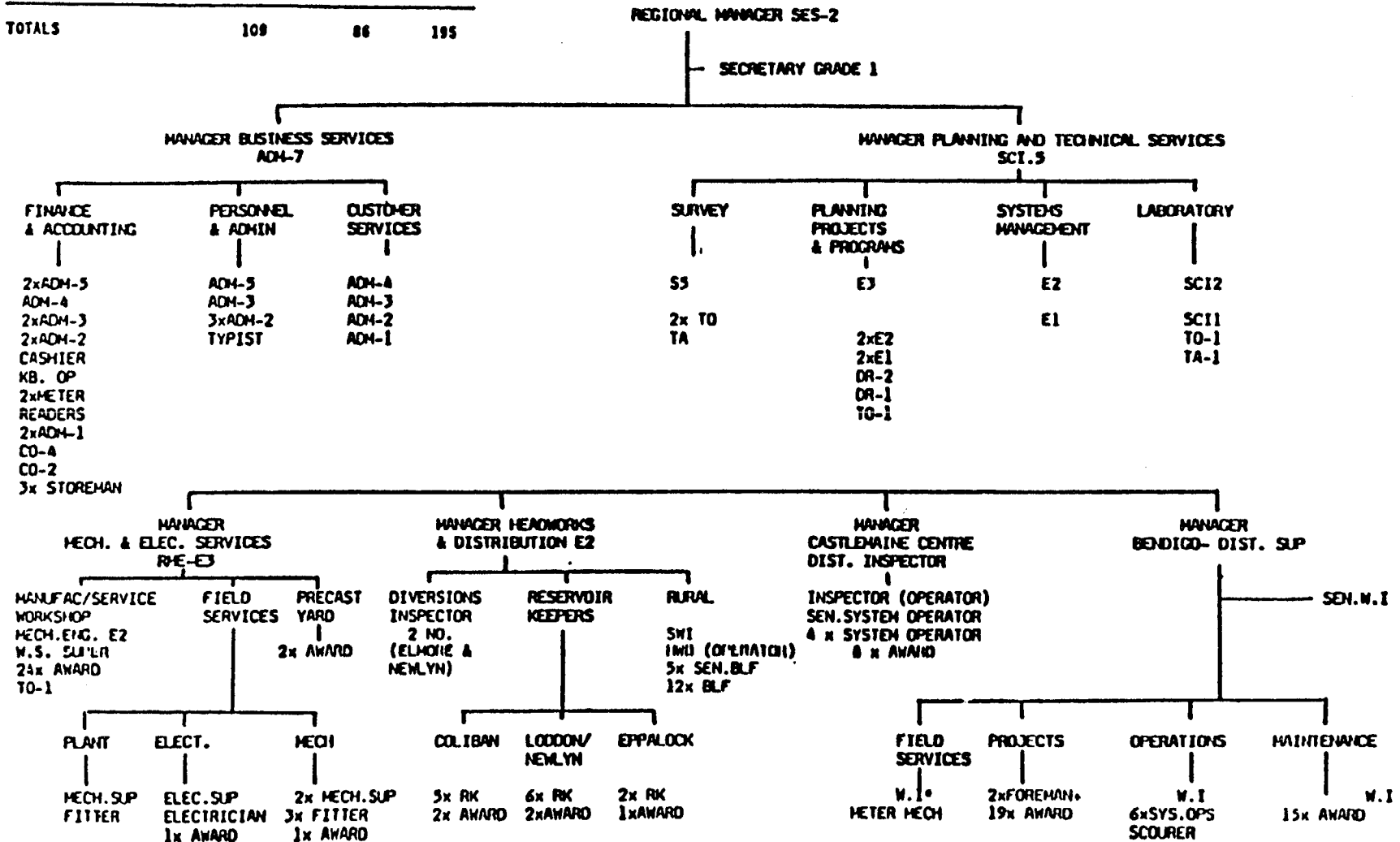
Investigations Branch (710)

Investigation of water resource development and management and groundwater and salinity management strategies.

Provision of technical support services to the Commission particularly in hydrology, geology, and hydrogeology.

SUMMARY	STAFF	AWARD	TOTAL
Regional Manager	1	-	1
Business Services	27	3	30
Planning & Tech. Services	19	-	19
Bendigo Centre	13	36	49
Castlemaine Centre	7	8	15
Headworks & Distribution	35	5	40
Mechanical & Electrical Services (CPW)	7	34	41
TOTALS	109	86	195

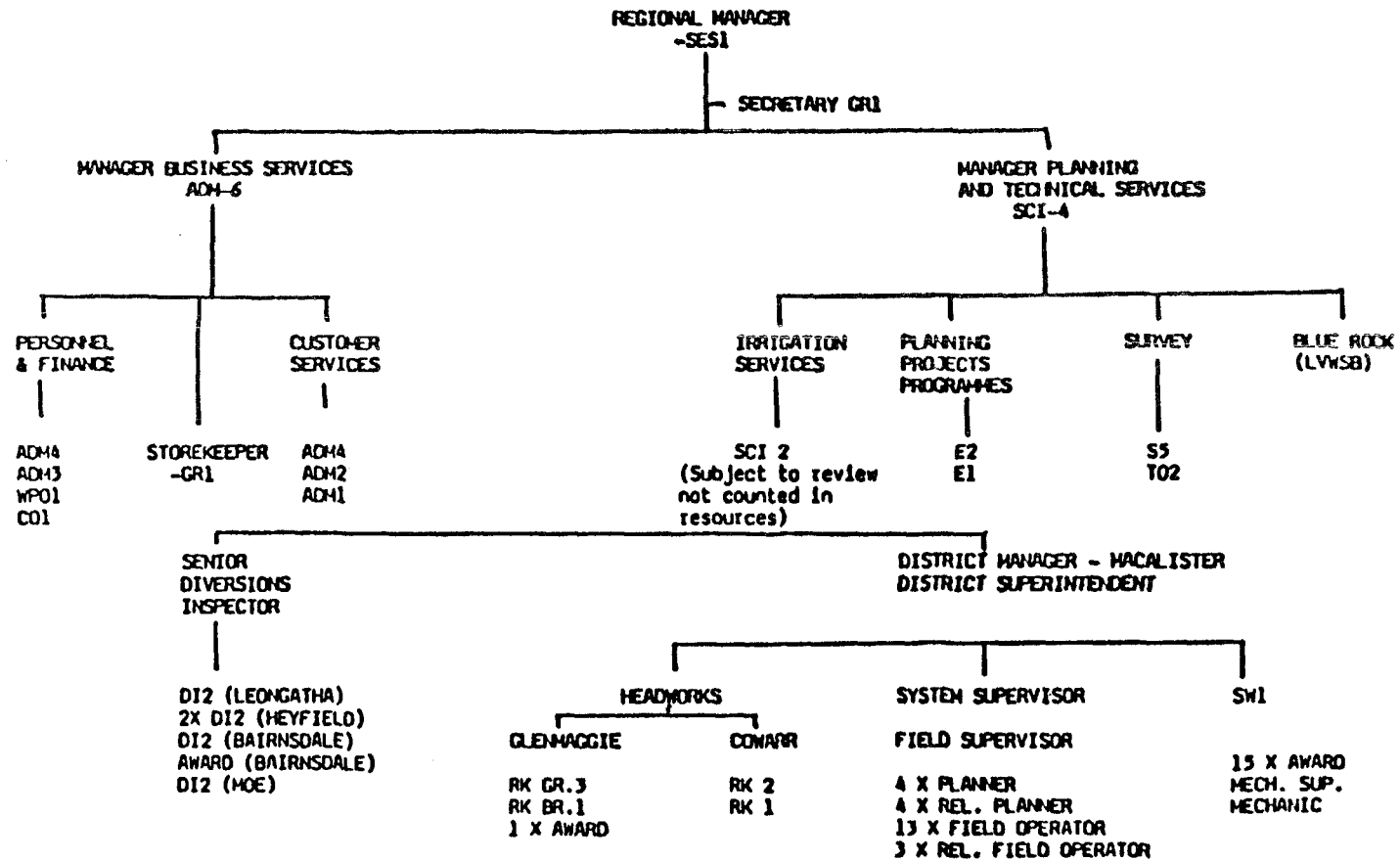
COLIBAN/CAMPASPE REGION
PROPOSED ORGANISATION CHART POST REGIONALISATION



*One is a working foreman
 *Plumbing Inspectors and contract supervisor

GIPPSLAND REGION

PROPOSED ORGANISATION CHART POST REGIONALISATION



SUMMARY	Staff	Award	Total
Regional Manager	1	-	1
Business Services	9	1	10
Planning & Tech. Services	5	-	5
Maffra Centre	33	17	50
Diversions	6	1	7
TOTALS	54	19	73

JULY 87

ANNEX 2.4

MOROCCO

IRRIGATION ADMINISTRATION ORGANIZATION OF
MOROCCO'S LARGE-SCALE IRRIGATION PROJECTS

A. BACKGROUND

1. Irrigated agriculture has a high priority in Morocco. Irrigation development is viewed as providing the means by which Morocco will be able to meet the need of its rapidly growing population and expand exports both of commodities and processed agricultural products in order to earn more of the exchange requirements of the country.

1. In Morocco, there are approximately 7.7 million ha of arable land of which 1.2 million ha are potentially irrigable. Irrigation accounts for 88 percent of the water use compared to 8 percent for domestic use and 4 percent for industry. Irrigated agriculture contributes about 45 percent of the agricultural value added and produces 65 percent of the agricultural exports. Government policy in the agricultural sector has always favored investments in the irrigation subsector. These investments have accounted for more than 60 percent of the total investment in agriculture since 1965. The goal is to put under perennial irrigation one million ha by the year 2000. This is referred to as the "million hectares" policy.

2. Large-scale irrigation projects (LSI) development constitutes the central thrust of Moroccan irrigation development efforts. LSI projects range from 20,000 ha to 250,000 ha and represent new investments in major civil works for water regulation and conveyance with modern distribution systems. In the development of the LSIs, Morocco has adopted an interventionist type of irrigation policy. This policy is supported by a comprehensive set of measures included in the 1969 Code of Agricultural Investments which constitutes a framework for promoting the rational use of resources within the LSIs. The Government regards the Code as a contract between the State and the farmers to build the national economy through irrigation development. It pays for the dams, the irrigation network and necessary on-farm development. It provides credit, selected seeds, farm equipment, and certain mechanized operations usually at subsidized prices. Finally, it guarantees the prices of crops such as sugar beets, sugar cane, rice, wheat, and cotton through contracts. In turn, the farmer is obligated to farm his irrigated land in the national interest, to follow the norms imposed for his hydraulic sector, and to repay the State through a land improvement tax and water charges. There are nine delimited LSIs in Morocco with an irrigation potential of 780,000 ha of which over 400,000 ha have been completed.

B. ORGANIZATION OF IRRIGATION ADMINISTRATION

3. Initially, an independent office, the Office National des Irrigations (ONI), was created (in 1961) with full responsibility of irrigated agricultural development in the country. ONI brought under a single roof all the various bureaus involved with Morocco's irrigation development. This office has introduced specialized crops such as sugar beet and developed in 1962 the land consolidation model known as "Trame B"¹ which is used in all the LSI projects ever since. In 1965/66 ONI, which became quite centralized, was dissolved in favor of a more decentralized approach and formation of autonomous regional offices attached to the Ministry of Agriculture and Agrarian Reform (MARA)² : the Offices de Mise en Valeur Agricole, ORMVA.

4. MARA has principal responsibility for the provision of public services to Moroccan agriculture. At the local level, MARA operates through two separate and distinct institutional structures: ORMVAS, which serve the large-scale irrigation perimeters, and the Directions Provinciales d'Agriculture (DPA), which have jurisdiction over most of the rainfed cropland and the small- and medium-scale irrigation projects. Figure 1 shows a simplified organization chart of MARA.

5. ORMVAS are responsible for the design, construction, operation, and maintenance of the irrigation networks. ORMVAS' technicians supervise farming operations for industrial crops and assist in the establishment and monitoring of agricultural cooperatives. ORMVAS integrate all the productive services required by farmers under one management structure. They distribute inputs, provide extension and mechanization services to farmers, supervise short-term credit and provide genetic improvement and health control services for livestock.

¹An interesting feature of LSI projects in Morocco is the model used for land consolidation and the irrigation system layout known as "Trame B" or "Rational Layout". The model is unique and incorporates three important complementary features:

- equitable and efficient water distribution;
- annual and seasonal crop diversity; and
- accommodation of wide variations in individual land ownership patterns in such a way that limitations in the size of individual land holdings are not obstacles to the adoption of modern technology.

²The study and exploitation of water resources in Morocco are the responsibility of the Hydraulics Administration of the Ministry of Public Works which is also responsible for dam construction and maintenance.

6. In addition, ORMVAS are responsible for providing assistance to rainfed farmers and those dependent on traditional irrigation that are located within their jurisdictions. They also provide technical assistance to local collectives in the design and construction of village infrastructure such as housing projects, electricity, and water supply, sewage and road systems, etc.

7. Recently, ORMVAS have embarked on a program of disengagement from activities that do not fall directly within their mandates. The objective is to make the private sector provide all those services that are commercial in nature. A new experience is now initiated with the ORMVA Doukkala. It consists of having this ORMVA operate like a "private" enterprise according to a program contracted with MARA. This experience is at its early stages. It is aimed at providing the ORMVA with more field spending authority.

C. ORMVA's ORGANIZATION

8. Each ORMVA is administered by a Board of Directors chaired by the Minister of Agriculture and composed of:

- (i) all the directors of the central directorates of MARA;
- (ii) representatives of all the Ministry departments involved with ORMVA's activities; and
- (iii) representatives of the national organizations of farmers.

9. At the local level a Technical Committee, which is chaired by the Governor of the Province and composed of local representatives of all the Ministry Departments concerned, as well as of farmers' representatives, meets once a month, or whenever it is necessary, to examine the issues and problems faced locally by the ORMVA.

10. A typical organization chart of an ORMVA is given in Figure 2. ORMVA is managed by a Director. At the headquarters level, the ORMVA is divided into departments with several bureaus or sections. Extension, which used to be a bureau of the crop production department, has been recently upgraded to a department with higher status and appropriate staffing. This results from the growing awareness that the ultimate responsibility of the ORMVAS is agricultural extension.

11. At the field level, ORMVAS operate through the "Centre de Mise en Valeur Agricole" (CMV). These CMVs are the basic units in which the plant and livestock development activities are integrated. Each CMV has one manager and at least one office employee, one employee responsible for the supply of inputs and several extension agents. For those crops for which

it supplies inputs (e.g., sugar beet, wheat, cotton, sugarcane), ORMVA through the CMVs determines the appropriate varieties of seeds, as well as the type and quantity of seed, fertilizer and pesticides per ha and specifies when the farmers will fetch and use the inputs. ORMVA also provides farm machinery services to farmers but this activity has been decreasing in light of its lack of effectiveness.

12. Most ORMVAS have established subdivisions which supervise the activities of the CMVs operating within their territorial boundaries and coordinate the activities of the various departments on the field.

D. ORMVA's BUDGET

13. ORMVAS are semi-autonomous organizations with an administrative and technical tutelar of the Ministry of Agriculture and Agrarian Reform and a financial tutelar of the Ministry of Finance. Each ORMVA has a separate budget within the national budget enacted each year. Separate budgets are appropriated for investment and operations. Water charges for O and M, collected by the ORMVAS remain with ORMVA. Loans to the Government of Morocco by international lending agencies for development projects are processed through the Ministry of Finance and reappropriated to the ORMVAS through the annual budget.

E. ORGANIZATION OF OPERATION AND MAINTENANCE

14. Before 1976, O and M sections were located either in the Equipment Department or the Crop Production Department and had a low status within the ORMVAS. Staffing for O and M was inadequate and personnel were not properly trained. It was difficult to attract people because design and planning staff were more highly regarded. The O and M budget was small because the emphasis was on equipping the systems and most of the budget was devoted to that end. Since 1976, much greater attention is being paid to O and M issues. In most ORMVAS, the O and M department operates at the field level through subdivisions which are typically organized as the primary responsibility for O and M rests still with the project ORMVAS officials. The creation of Water Users Associations that would formally undertake part of the O and M duties has been slow and is really at its early stages in most LSI perimeters. However, it is worth mentioning the attempt made in the Haouz project to make the traditional farmer organization undertake some of the O and M duties up to the secondary canal. This experience has been successful mainly because the layout of the modern system was superimposed on the traditional one in a manner that did not jeopardize the existing traditional social organization.

15. A new law in 1984 was designed to facilitate the process whereby ORMVAS create Water User Associations with responsibility for O and M to the maximum extent possible.

Fig.1: SIMPLIFIED ORGANIZATION CHART OF MINISTRY OF AGRICULTURE AND AGRARIAN REFORM, MOROCCO

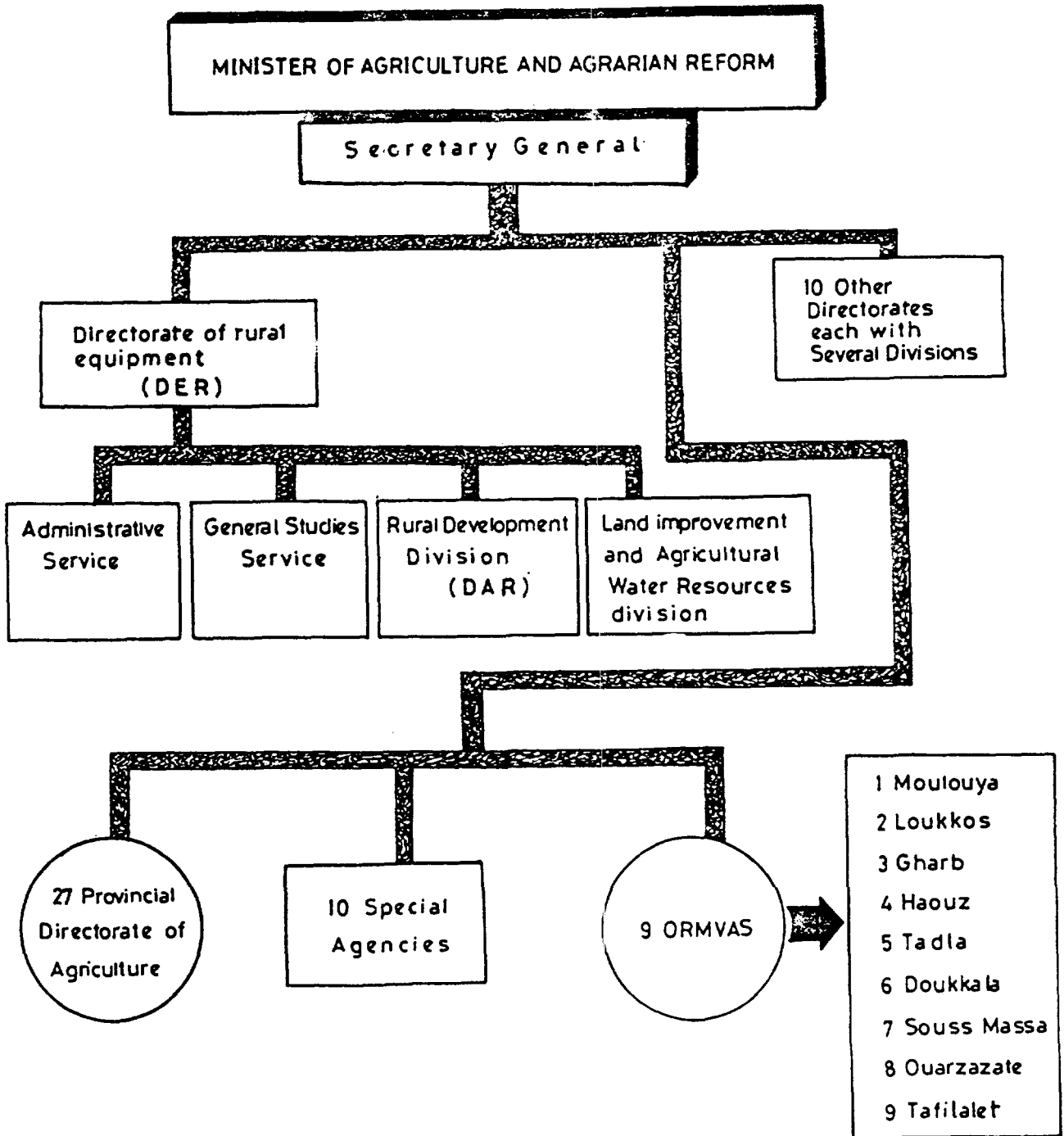


Figure 2: - TYPICAL ORGANIZATIONAL STRUCTURE OF THE ORMVAS.

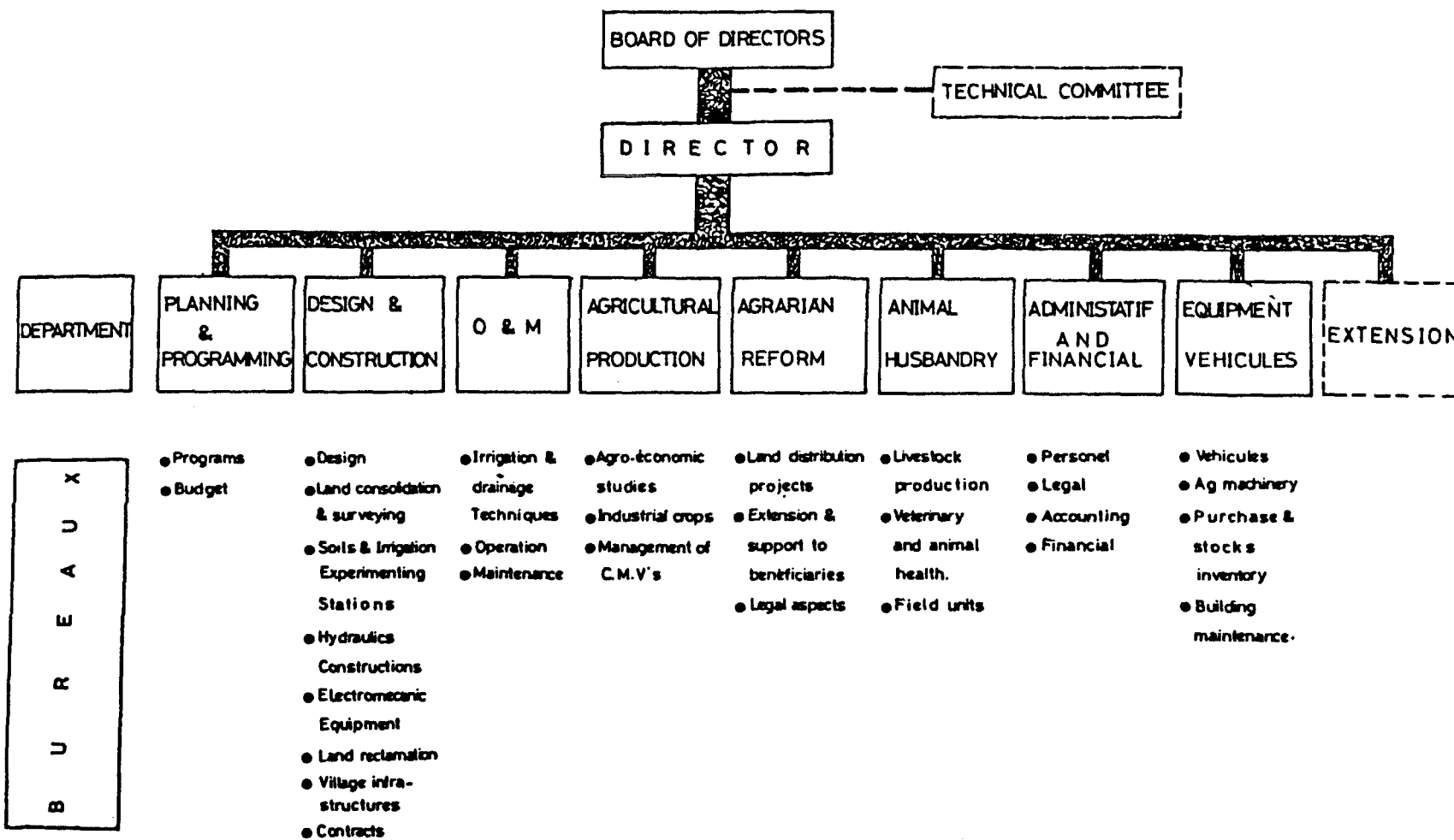


Fig. 3 : ORGANIZATION CHART OF O & M DEPARTMENT
(ORMVA GHARB)

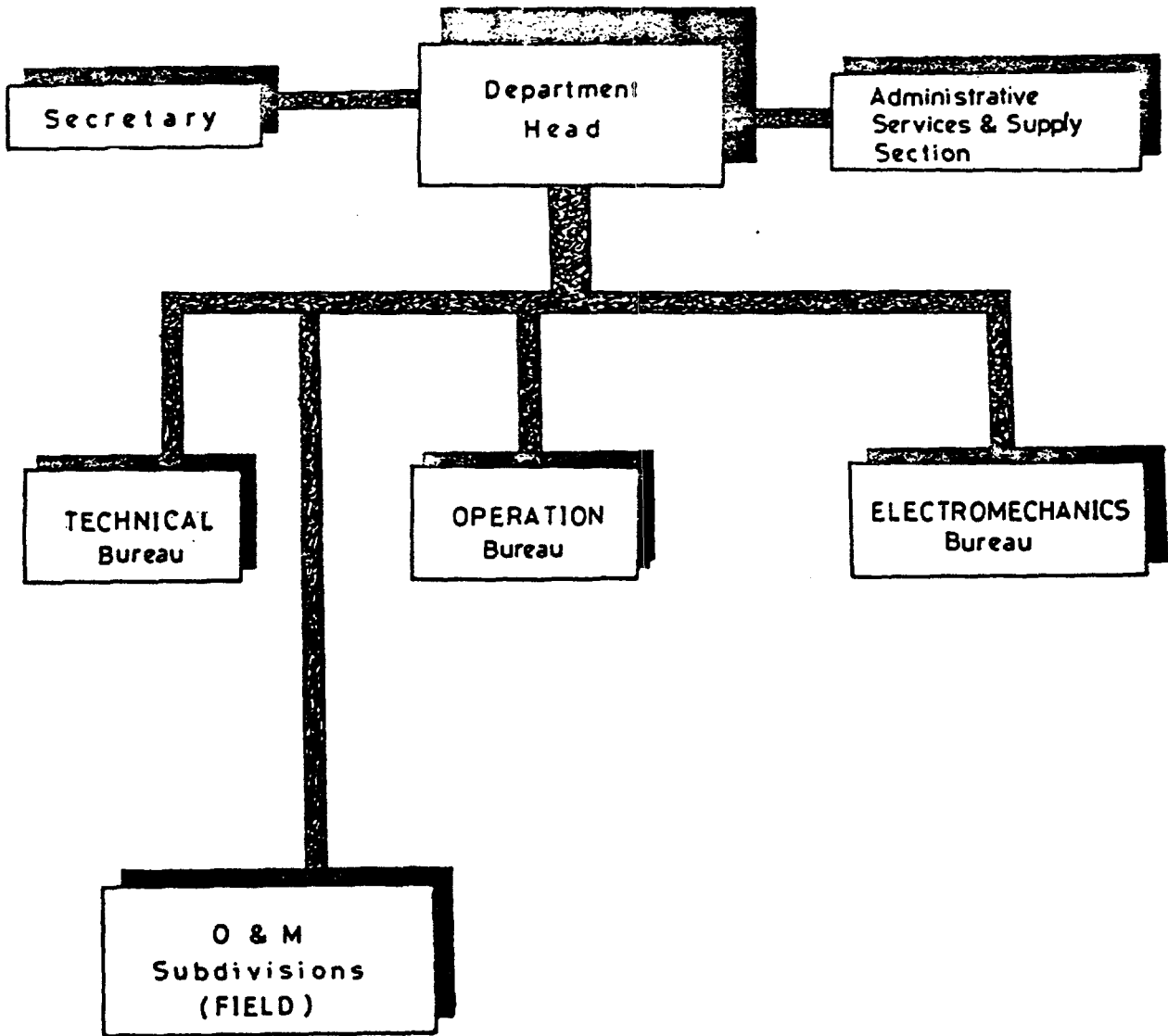
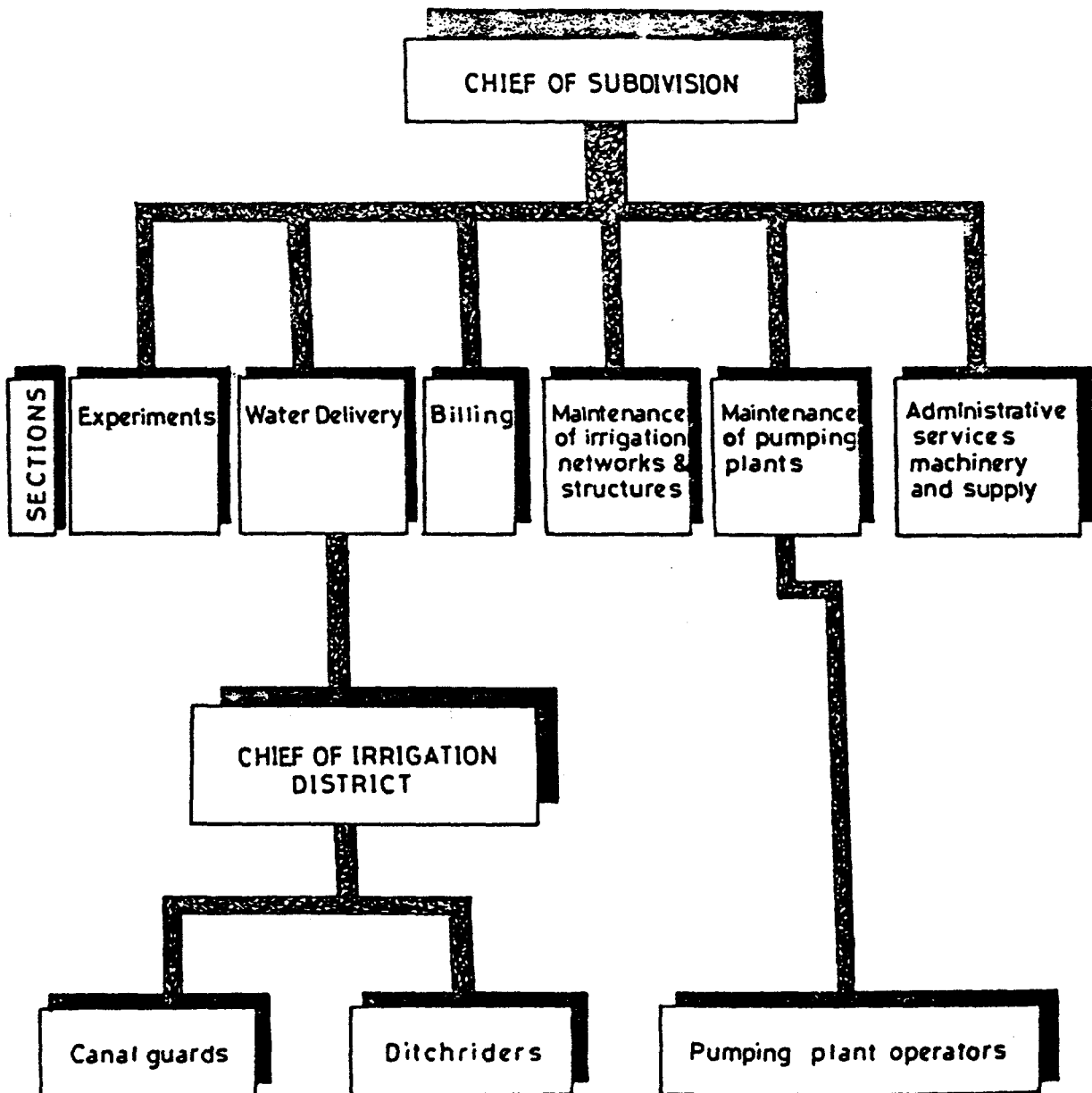


Fig. 4: ORGANIZATION CHART OF O & M SUBDIVISIONS
(ORMVA GHARB)



ANNEX 3

SUPPLY SERVICES - OBJECTIVES FOR PLACING ORDERS

<u>ESTIMATED VALUE OF REQUIREMENT</u>	<u>OBJECTIVE</u>	<u>COMMENTS</u>
\$0 - \$1,000	5 Working Days	The objective given is for requisitions where contact with suppliers can be made by telephone. Where it is necessary to send out information by mail (e.g., drawings, etc.) lead time could extend to 3 weeks.
\$1,000 - \$5,000	4 Weeks	Written offers are generally involved in this range to comply with G.S.S.A. guidelines. The lead time if therefore extended to allow written offers to be made. In instances where written offers are not required (e.g., sole supplier) the time required will be shortened.
\$5,000 - \$100,000 (Where assessment is made by Supply Services)	5 Weeks	These requirements generally require that tenders be advertised. Exceptions can be made where only one supplier exists (e.g., Ductile Iron Pipe). However, if alternatives are to be considered, tenders are required.
\$5,000 - \$100,000 (Where assessment is made by others)	5 Weeks plus assessment time	Where an assessment of offers is to be made by the user and others with an overlapping responsibility, the time taken for this assessment is to be added to standard lead time shown.
\$100,000 - \$250,000 (Where assessment is made by Supply Services)	6 Weeks	The additional time involved is required for assessing, drafting and typing a submission and gaining approval of the Director, Finance and Administration to place an order.
\$100,000 - \$250,000 (Where assessment is made by others)	6 Weeks plus assessment time	Refer previous note re: Assessment of Tender by others.
Greater than \$250,000 (Where assessment is made by Supply Services)	8 Weeks	In this instance approval of the General Manager must be obtained and then written sanction of the Executive Council must be sought and obtained prior to placing an order.
Greater than \$250,000 (Where assessment is made by others)	8 Weeks	Refer to previous note re: Assessment of Tender by others.

TYPICAL ORDERING/PURCHASING/RECEIPT PROCEDURE

FOR MATERIALS REQUIRED AT A COUNTRY CENTRE

Eg. Supply of RC Pipes
Estimated Value \$50,000

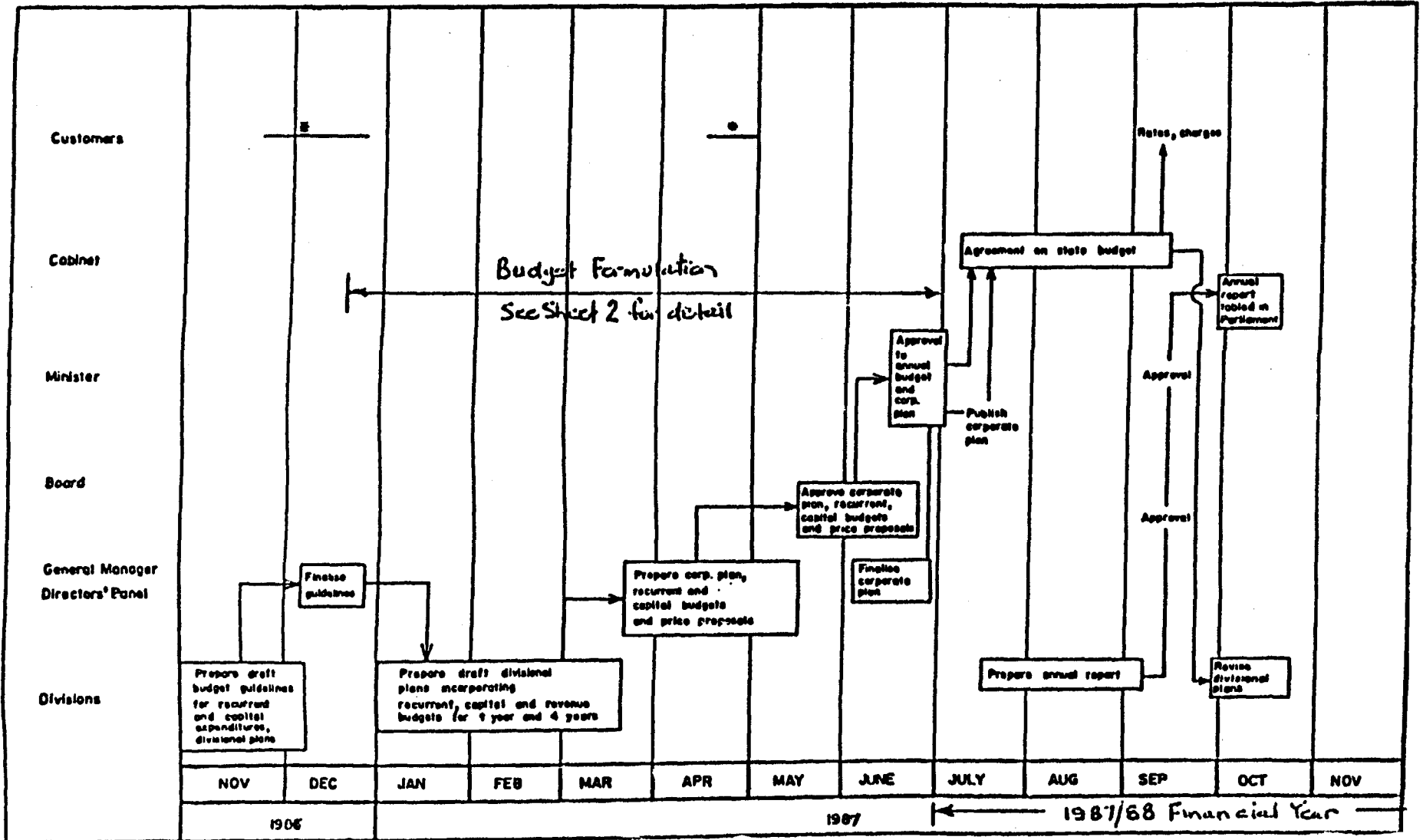
FLOW CHART OF ACTIVITIES

<u>Activity</u>	<u>Approximate Time Required</u>
1. Local Inspector identifies need for stores requirement from works plan	1 day
2. Prepare requisition stipulating exact material requirements including quantity, size, grade, pressure, specification details, desired delivery date, site and any special requirements	2 days
3. Submit requisition to Supply Branch	2 days
4. Supply Branch initiates purchase by inviting tenders/quotations from suppliers	3 weeks
5. Tenders/quotations received and collated by Supply Branch. Tenders evaluated in conjunction with client and technical specialist branch (if necessary)	1 week
6. Acceptance of best offer arranged by Supply Branch, including statutory approvals as necessary. Place order	1 day
7. Supply Branch advises unsuccessful tenderers	1 day
8. Arrangements made for technical inspection of goods as manufactured at factory prior to delivery	As required
9. Local inspector to ensure arrangements made for receipt of goods (site access, receiving office, etc.)	As required

- | | | |
|-----|---|--------------------|
| 10. | Goods delivered and checked for condition and compliance with order | As stated in order |
| 11. | Goods receipted and authority issued by receiving officer for payment in accordance with terms of order | 1 day |

ANNEX 4

Program for development of 1987 Corporate Plan and 1987/8 Budget



• Key consultative phases

1987/88 BUDGET TIMETABLE

- Note: Timetable anticipates DMB budget timetable. Any changes resulting from release of DMB timetable will be incorporated when available.
- 09/01/87 Distribution of 1987/88 budget package including General Manager budget guidelines and budget documentation to RA Managers and FE Managers as applicable. Budget package will include requirement to identify recurrent expenditure and capital expenditure projections per component for 1988/89 and 1989/90.
- 13/02/87 Consultative process between Service Units, RA and FE Managers completed. RA's to return relevant form to DFA identifying service unit requirements for 1987/88.
- 20/02/87 Revised 1986/87 Budget (Recurrent, Capital and Revenue) and forward look estimates on unchanged policy basis provided to Department of Management and Budget and Minister.
- 27/02/87 Budget package completed including initiatives and returned by RA Managers to Directors. Directors to review budgets in conjunction with FE Managers and approve the estimates for inclusion in Draft Commission budget for 1987/88 to be finalised on 14/5/87.
- Copy of estimates provided to Finance and Administration Division for entry to General Ledger.
- Revenue budget estimates options per financial entity prepared by Finance and Administration Division for consideration by FE Managers.
- 06/03/87 Budget package as approved by each Director provided to General Manager and Finance and Administration Division for correction (if any) to estimates entered the previous week into General Ledger by Finance and Administration Division.
- Estimates approved by each Director provided to Corporate Planning for review of priorities.
- 13/03/87 General Manager to review RA budgets and approve their inclusion in the Draft Commission Budget for consideration at the Board meeting on 15/5/87.

- 13/03/87 Following approval by General Manager Finance and Administration Division commence preparation of Draft Commission budget.
- 03/04/87 Revenue budget estimates as amended if required by FE Managers returned to Finance and Administration Division from applicable Directors.
- 06/04/87 All Advisory Boards and/or Peak Councils to meet during the period commencing 13/4/87 to 1/5/87 and recommend to the Commission and Government, rates of return, indicative price levels, subsidy levels (if any), recurrent and capital expenditure levels for 1987/88 and projected figures for 1988/89 and 1989/90.
- 27/04/87 Draft Commission Budget for 1987/88 including initiatives considered by General Manager and Directors' Panel. Directors to present to the General Manager RA and FE budget for those areas within their responsibility. One revenue option to be chosen for presentation of profit and loss, balance sheet and cash statements per business FE and for the Commission in total. Impact of alternatives will be shown on financial models.
- 14/05/87 Commission Budget for 1987/88 and financial plan 1987/88 - 1989/90 including consumer group recommendations presented to Board for consideration and guidance. Draft Budget provided by Board to Minister for advice.
- 05/06/87 Revised Budget presented to General Manager for approval (incorporating any changes resulting from consultations with consumers, revised priorities, Board and Ministerial advice).
- 13/06/87 Policy initiatives for 1987/88 provided to Department of Management and Budget for consideration by the Priorities Planning and Strategy Committee of Cabinet.
- 1987/88 Program Structure and narrative provided to Department of Management and Budget.
- 18/06/87 Budget presented to Board for approval.
- 30/06/87 Budget presented to Minister for approval.
- Budget provided to Department of Management and Budget for inclusion in first draft State Budget.
- July - August Discussions and negotiations with the Department of Management and Budget on details of the 1987/88 Budget and initiatives.

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